By Gary Frasier

Frasier's Philosophy

I recently read an article in the local newspaper about how it is costing about double what is obtained in grazing fees to administer the public rangelands. The opponents of public land grazing use the argument that the only returns are the fees paid the lessee (and sometimes the local economy) and that if the land was not being grazed, then expenses would be reduced. This is an old controversy that keeps bouncing back.

The management costs of pubic lands are not concerned solely with the grazing aspects. Most of the public lands are the watershed for providing water to downstream users. There are some costs associated with watershed functions. This water has a value that should be included in a cost-benefit analysis. There is recreation on most public lands. The costs for overseeing recreation activities are not always separated from the management of grazing on the lands. There are other activities on public lands, such as timber and mining, that incur costs. A true assessment must include all costs and benefits, tangible and intangible.

This leads me to the theme of this issue of *Rangelands,* "Managed Livestock Grazing." It is recognized that past livestock grazing has been detrimental to the sustainability of the ecosystem in many places. There are also instances where, with the removal of all grazing, there is no improvement of the ecosystem. In other places, proper livestock grazing can assist ecosystem improvement. This is all old news to many range managers. I am "preaching to the choir."

I do this as a reminder that while many of us know these items to be true, there are others, including some of our local neighbors, who do not realize there may be a benefit of "managed livestock grazing" on our rangelands. I live in a "35-acre ranchette developed" area. Over half my neighbors have too many horses, llamas, or other animals for the forage resource on the land. They buy some feed, but the animals have destroyed most of the desirable vegetation. It is a source of weeds and, during rainstorms, severe soil erosion. During the dry, windy spring periods, there is dirt blowing.

There are many areas where we (as a society) need to do a better job of managing the land. As a society (SRM) of range managers, we are missing an opportunity and maybe a responsibility to assist, inform, teach, and lead the way to manage all rangelands, not only the big ranches but also the smaller acreages. This is a potentially much bigger constituent than the present membership of SRM.

I would encourage everyone to read the article by Buckhouse and Williams in the December 2005 issue of *Rangelands.* This article points out what SRM has done in the past and would be a good starting point for the future.

I do not advocate livestock grazing on every acre of rangeland. I do believe that in many areas, properly managed livestock grazing is compatible with other activities on rangelands. Let's get the message out. ◆

Managing Cows With Streams in Mind

By Pete Bengeyfield

Many streams in the West today have been damaged by livestock, resulting in broken banks; scraggly willows; wide, shallow channels; dirt in the stream; and weeds on the stream bank. I think we can all visualize the picture. But it doesn't have to be that way.

There are solutions to the riparian problems that are the flashpoint of so many battles in the West today. To be effective, the solutions have to be site-specific and feasible for management; they must also include a good dose of common sense. If any of these components are missing, the solution will likely fail. On the Beaverhead–Deerlodge National Forest in southwest Montana we think we've developed a mechanism that allows all these components to interact and create a situation in which streams can recover and stay healthy over the long term in the presence of livestock grazing. On one allotment, the results of this effort have initiated recovery in stream channels that were previously impacted by livestock, and are now in a decided upward trend.

Importance of Stream Channels

For years, much of the research associated with riparian areas concentrated on vegetation (willows, alders, cottonwoods, sedges) and the various benefits they provide. And there can be no doubt that the shade, cover, nutrients, and erosion prevention that occur as a result of having a healthy riparian plant community all combine to give riparian areas an importance disproportionate to their size in the arid Intermountain West. Consequently, when standards are developed to assess the impacts of livestock on riparian areas, they are often in terms of effects on vegetation.

Figure 1.

Ignored in all the attention on vegetation was the physical component of riparian systems, the stream channel. (The first widespread riparian assessment method to routinely

Figure 2.

include the stream channel, the Proper Functioning Condition methodology, didn't appear until 1993.) In reality it is the channel that collects and distributes water, making it perhaps the most important factor in whether or not plants are successful.

The stream channels we see on the landscape today have evolved based on the various climatic and geologic changes that have occurred over time. Their shapes, steepness, and sinuosity (how crooked they are) all combine to move water and sediment through the landscape in the most efficient manner. As by-products of this efficiency, they spread water throughout the valley bottoms, increase the storage of water in stream banks, and support streamside plants (which, in turn, keep their banks from eroding). Consequently, when setting standards for riparian condition, we need to look at the stream channel as well as at the streamside plants to determine when livestock need to be moved.

The key to maintaining the stream's efficiency, and thereby ensuring all the other benefits, is to make sure that the channel (shape, steepness, sinuosity) that should be on that site given the type of valley it's in, as well as its climatic and geologic history, is actually there.

Of all the indicators of a correct channel type, the channel cross-section—the relation between its width and depth—is perhaps the most revealing. For it is this relationship that determines whether or not the stream can perform the various tasks that lead to a healthy riparian area. Streams most affected by livestock occur in meadows, which are generally in fairly wide valley bottoms with little slope. This physical setting produces streams that are flat, crooked, narrow, and deep. Streams with these characteristics effectively move sediment because their velocity varies little across the channel; they reduce stream-bank erosion because they flood at regular intervals, thereby spreading out peak flows; they maintain saturated stream banks because they are deeper than they are wide, thereby supporting riparian vegetation with strong root systems; and they produce good fish habitat in the form of undercut banks. Figure 1 shows a well-functioning meadow-type stream of the kind that is most susceptible to livestock. It is narrow and deep, with dense willows and sedges on the banks, and these species extend outward to the change in slope that defines the floodplain.

This brings us back to where cows become important. The most widespread impact livestock have on riparian areas is trampling stream banks. Trampling can cause an increase in stream width, making the channel wider and shallower, with slower-moving water. As a result, sediment is deposited in the center of the channel rather than on the banks; less water gets to the floodplain so bank erosion increases; the storage of water in the banks decreases, forcing streamside plants to shift from willows and sedges to drier site species with less dense roots; and fish habitat is lost. Clearly, if we are going to maintain riparian areas, we are going to have to limit the amount of stream-bank alteration as a result of livestock trampling. Figure 2 shows a reach that has been heavily damaged by trampling. The stream is wide and shallow, with poor riparian vegetation on the stream banks, and it has a high amount of fine sediment in the channel bottom.

The Beaverhead Riparian Guidelines

When I came to the Beaverhead National Forest in 1984, my career up to that point had been spent on the "timber" forests west of the continental divide. I was familiar with the more traditional effects of Forest Service activities on streams—sediment from roads and increased water yield from timber harvest. The Beaverhead was a little different. The high elevation, cold climate, and sparse rainfall dictates that forests are more scattered and the trees small. So, on the Beaverhead, timber harvest doesn't affect a lot of streams.

But livestock grazing does. Livestock have been in southwest Montana since the 1860s, when they were brought in to feed the mining camps of Bannack and Virginia City. Virtually all of the Beaverhead Forest aside from the high alpine areas is in grazing allotments, and all of the streams for a good portion of their length are accessible to cows. Over the years of monitoring 382 permanently established cross-sections on meadow streams susceptible to livestock damage, significant changes have been shown at the 95% level. Streams became wider, and had higher levels of fine sediment and a greater stream-bank erosion hazard. This translates into 41% of those 382 stream reaches being classified as nonfunctioning or functioning at risk.[1]

To address this problem, Dan Svoboda, our soils scientist, and I developed the Beaverhead Riparian Guidelines.[2] These guidelines describe a process for moving livestock through the pasture rotation based on easily measured indicators that deal directly with livestock effects on stream channels and riparian vegetation. There are 4 indicators, which are measured to determine livestock movement: forage utilization, stubble height, woody browse, and streambank alteration. Measurement techniques are cited in the literature: stubble height;[3] riparian shrub utilization;[4] streambank alteration,[2] and forage utilization.[5] Site speci-

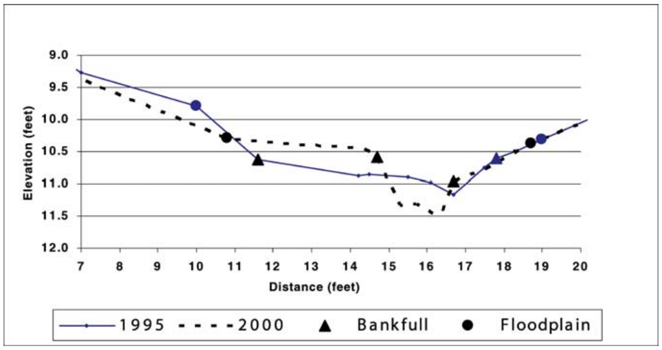

Figure 3.

ficity is stressed in each case, and the actual standard varies by stream type, vegetative type, and existing condition.

The following examples show how 2 streams on the Warm Springs Allotment, in the Ruby River watershed, have responded to the implementation of these guidelines over a period of 7 to 9 years. In 1993, the following levels for each indicator were prescribed for moving livestock: forage utilization, 50%; woody browse, change in livestock preference from grass to woody vegetation; streambank alteration, 30%; stubble height, 4 inches.

Results

The Warm Springs Allotment is located in the Gravelly Mountains, about 40 miles northwest of Yellowstone National Park. It is fairly high-elevation, open rangeland (70% suitable range) with patches of timber. Prior to the early 1990s, heavy grazing pressure was common in riparian areas, and many streams were in nonfunctioning or functioning-at-risk status as a result (Beaverhead–Deerlodge National Forest, unpublished data). There are approximately 5,900 AUMs on the allotment.

Permittees on the Warm Springs Allotment voluntarily began using the Guidelines to move cattle in 1993, and are responsible for the day-to-day monitoring and livestock movement. They employ 2 full-time riders who make liberal use of herding dogs. In 1995, stream surveys were installed throughout the allotment for the purpose of monitoring riparian recovery and function.

The Timber Creek site is on a reach of stream that was judged to be nonfunctioning in 1995 as a result of the cross-section becoming wider and shallower from livestock trampling of the stream banks. In 1995, stream-bank alteration (the linear distance along stream banks where livestock had caused stream widening through trampling during the current year) was consistently 80% or higher. Consequently, it was determined that livestock would be moved when stream-bank alteration reached 30%. In 2000, stream-bank alteration by livestock was 17%. After 7 years under the Guidelines, the cross-section had become deeper and narrower, and was beginning to resemble the shape of a channel that reference data from a similar valley bottom shows should occupy this site. The width of the channel had been cut in half (4.1 feet to 2.0 feet), and deposition had begun to develop a floodplain on the left bank. Vegetation in the form of sedges colonized the deposition, leading to further stabilization. Figure 3 displays the change in cross-section between 1995 and 2000.

Sawlog Creek is another stream on the Warm Springs Allotment that was impacted as a result of stream-bank trampling by livestock. Trampling was measured at 45% in 1995, and again it was determined that livestock would be moved when stream-bank alteration reached 30%. In 2001, stream-bank alteration by livestock was 15% in this reach.

Changes in the stream cross-section at Sawlog Creek were similar to those at Timber Creek, but perhaps a better indicator of the effects of the reduction in trampling on Sawlog Creek is the graph in Figure 4. This graph shows the distribution of 50 stream widths along approximately 200 feet of Sawlog Creek. The horizontal axis portrays the range of widths, and the vertical axis shows how often any given width occurs. For example, in 1995 (the solid line), 50% of the reach was about 5.8 feet wide or less. By 2001 (the dashed line), the channel had narrowed so that 50% of the reach was about 3.3 feet wide or less. This method of displaying changes in stream width shows that reducing stream-bank trampling over a period of 5 years allowed the channel to become narrower for a considerable distance.

Discussion

When the Guidelines were first used on the Warm Springs Allotment, each of the 4 "triggers" (forage utilization, woody browse, stubble height, and stream-bank alteration) was measured to establish which one would be used to move livestock. In each case, stream-bank alteration was the one that came into play first, and the one that was established as the long-term indicator that would require livestock to be moved. It should be noted that the consistent movement of livestock throughout the grazing season allowed the standard to be achieved with a wide margin of success. Although it was permitted to have 30% stream-bank alteration on Sawlog and Timber creeks, when the allotted time in the pasture was up, actual stream-bank alteration was consistent-

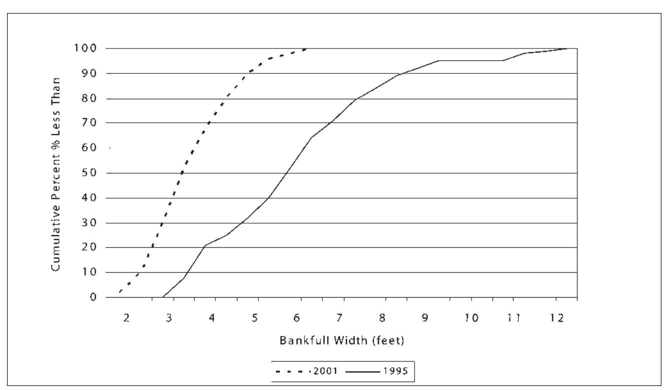

Figure 4.

ly in the 15%–20% range. In other words, by moving livestock and meeting the stream-bank alteration standards, the permittees were able to utilize a pasture for the full time.

Although the amount of improvement differed from site to site, an upward trend in the shape of the stream channel occurred where the Guidelines were met. These responses were evident over a 4- to 6-year period. Generally, stream width became narrower, forcing the channel to become deeper at the same time. In each case, vegetation improvements kept pace with physical changes as sedges became established on stream banks.

The improvement of these streams was brought about by an increase in livestock management by the permittees. Cows were gathered in small bunches and herded away from riparian areas to locations where they would remain for a period of days. Eventually, they would drift back to the riparian areas, where they would be gathered and moved again. A key in the effectiveness of this tactic was the large amount of suitable range (nontimbered areas with adequate forage) on the allotment. Allotments that have most of the suitable forage concentrated in riparian areas, are substantially timbered, and have limited off-site water, will be far more difficult to manage.

The positive effects of having a stream-bank alteration standard can be seen across the forest as well as on an individual allotment. Each year the Beaverhead–Deerlodge randomly chooses one allotment per ranger district for an end-of-season review. The goals of these reviews are to determine the following: 1) if the standards are being met, and 2) if they are being met, whether or not the streams are improving.

By combining the results of the 1999 and 2000 end-of-season reviews it is possible to assess compliance on 72 measurements of forage utilization, stubble height, and stream-bank alteration for 14 stream reaches. The average utilization standard was 45%, and this level was achieved in 59% of the cases. Stubble height standards averaged 4 inches and were achieved in 60% of the cases. Stream-bank alteration standards averaged 23%, and were achieved in only 28% of the cases. It appears that the forage utilization and stubble height standards, both of which were set at levels that are common throughout the West, are easier to meet than is the bank alteration standard. However, the only streams that showed significant improvement were those where the stream-bank alteration levels were met. Neither a forage utilization of 45% nor a stubble height at 4 inches initiated the upward trend in stream channel shape that is necessary to achieve riparian function.

Conclusions

Riparian improvements similar to those on the Warm Springs Allotment have occurred on other allotments on the Beaverhead–Deerlodge where the riparian guidelines have been successfully implemented. Here are some lessons we've learned that might be helpful to others around the West:

1. The Beaverhead Riparian Guidelines are an effective tool to improve nonfunctioning and functioning-at-risk riparian areas.
2. In many instances, stream-bank alteration is the most powerful of the triggers.
3. The key to successfully improving stream conditions in the presence of livestock is having the commitment of the agencies, the permittees and riders, and the interested public.

The importance of the third lesson cannot be overstated. Having a workable, site-specific proposal will look good on paper. Having all the parties support the solution will make the ground look good as well.

This conflict over riparian areas isn't going to go away anytime soon. The only way to diffuse it is to demonstrate that stream recovery to a functioning condition can be achieved in the presence of livestock. The Beaverhead Riparian Guidelines are one tool to accomplish that.

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Grazing Impacts on Rangeland Vegetation: What We Have Learned

Livestock Grazing at Light-to-Moderate Intensities Can Have Positive Impacts on Rangeland Vegetation in Arid-to-Semiarid Areas.

By Jerry L. Holechek, Terrel T. Baker, Jon C. Boren, and Dee Galt

Introduction

Conflict over livestock grazing in the western United States has increased as the land base in the West has shrunk due to rapid human population increase, urban sprawl, and lessened ties of much of the public to agricultural production. Antigrazing activists are making considerable use of the legal systems and media to further their cause. At the same time western ranchers have gained staunch supporters and stiffened their resolve to preserve their ranching heritage. It is our observation that both groups often present their cases more on the basis of emotion than sound scientific information. Impacts of managed livestock grazing compared with grazing exclusion on rangeland vegetation of the western United States have become better understood during the past 20 years as a result of more research and the publication of study results. However, most of this research is in highly technical, peer-reviewed journal articles that are generally not read by the public at large. We believe a careful analysis of the research on managed livestock grazing compared with grazing exclusion is needed to provide the public, ranchers, lawmakers, government planners, and conservationists with a sound basis for decision making. Semiarid and arid areas will receive emphasis because livestock grazing is most controversial on the public rangelands of the western United States. We will not attempt to exhaustively evaluate all the grazing studies in the western United States. Instead, we will

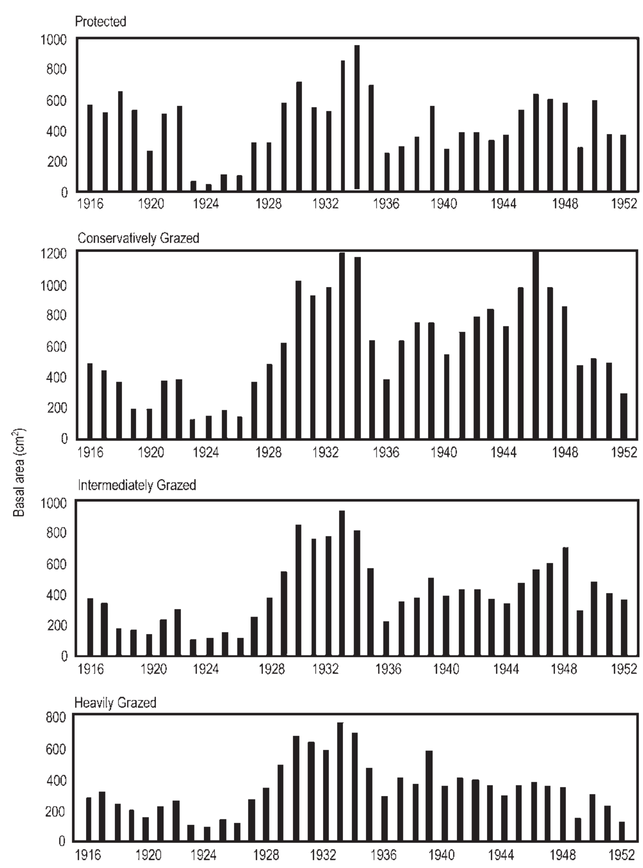

Figure 1. Basal area of black grama on meter-square quadrats protected from grazing and at 3 intensities of grazing on the Jornada Experimental Range, southern New Mexico, 1916–1953 (from Paulsen and Ares[2]).

Table 1. Description of grazing intensity categories		
Qualitative grazing intensity category	**Use of forage by weight (%)**	**Qualitative indicators of grazing intensity**
Light to nonuse	0–30	Only choice plants and areas show use. There is no use of poor forage plants.
Conservative	31–40	Choice forage plants have abundant seed stalks. Areas more than 1 mile from water show little use. About one-third to one-half primary forage plants show grazing on key areas.
Moderate	41–50	Most of accessible range show use. Key areas show patchy appearance with one-half to two-thirds of primary forage plants showing use. Grazing is noticeable in zone 1–1.5 miles from water.
Heavy	51–60	Nearly all primary forage plants show grazing on key areas. Palatable shrubs show hedging. Key areas show a lack of seed stalks. Grazing is noticeable in areas over 1.5 miles from water.
Severe	61+	Key areas show a clipped or mowed appearance (no stubble height). Shrubs are severely hedged. There is evidence of live stock trailing to forage. Areas over 1.5 miles from water lack stubble height.

Source: Based on Holechek et al.[1]

closely examine those that have compared carefully controlled intensity, timing, and frequency of grazing with grazing exclusion. The reader is referred to Holechek et al.[1] for a detailed review of various studies comparing grazing outcomes under different stocking rates and rotation systems.

Vegetation Trends

In western North America, we found 20 studies with some degree of replication in time and space that compare vegetation responses of grazing at moderate-to-light intensities with grazing exclusion. A description of the different categories of grazing intensity is provided in Table 1. These studies are summarized in Table 2. Sixteen of these studies evaluated trend, 11 evaluated productivity, and 2 evaluated drought responses on lands under managed grazing compared with grazing exclusion. Only 7 of the studies involve arid rangelands. Studies that did not provide some type of quantitative or qualitative characterization of grazing intensity, timing, and frequency were excluded from our review.

Figure 2. After 5 years of below-average precipitation, perennial grass production and vegetation composition were the same under conservative grazing (left) and 21 years of grazing exclusion (right). Vegetation composition was the same both outside and inside the exclosure. This photo was taken in early November 2003 on short-grass rangeland in west-central New Mexico.

Fourteen of the 18 studies evaluating trends had sufficient baseline information so that vegetation changes through time could be determined. In all 14 of the studies, ungrazed and moderately-to-lightly grazed treatments showed the same trend. Ten studies showed an upward trend, 2 showed a downward trend, and 2 showed no definite trend. Paulsen and Ares[2] reported a downward trend on Chihuahuan Desert rangeland due to drought, and Skovlin et al.[3] associated a downward trend on coniferous forest rangeland with increasing tree cover. In 6 of the 18 studies, plant community composition did not differ between grazed and ungrazed areas. Grazed areas were considered to be in higher ecological condition (more climax vegetation) in 5 studies and lower in 5 studies when compared with ungrazed controls. Two studies[2,4] merit special consideration because they involved long time periods (more than 20 years), were well replicated in space, and provided detailed characterization of grazing intensity. In both studies, grazing was found to be sustainable at intensities that involved up to 40% use of forage.

On the Colorado short-grass prairie, prickly pear cactus biomass was lowered by 56 years of moderate grazing (40% use) compared to exclusion.[4] Shrub biomass (mostly fringed

Table 2. Studies comparing vegetation responses of controlled grazing at moderate-to-light intensities with grazing exclusion

Range type	Location	Vegetation responses studied	Grazing treatment	Reference
Northern mixed prairie	Alberta, Canada	Production	Light grazing, grazing exclusion	Johnston[17]
Northern mixed prairie	North Dakota	Trend	Moderate grazing, grazing exclusion	Brand and Goetz[18]
Northern mixed prairie	Alberta, Canada	Trend	Grazing intensities, grazing exclusion	Smoliak et al.[19]
Northern mixed prairie	Montana	Trend	Conservative stocking, grazing exclusion	Vogel and Van Dyne[20]
Southern mixed prairie	Texas	Productivity, trend	Stocking rates, grazing systems, grazing exclusion	Wood and Blackburn[21]
Southern mixed prairie	Texas	Trend	Stocking rates, grazing systems, grazing exclusion	Thurow et al.[22]
Southern mixed prairie	Texas	Productivity, trend	Stocking rates, grazing exclusion	Heitschmidt et al.[23]
Southern mixed prairie	Texas	Productivity, trend	Stocking rates, grazing systems, grazing exclusion	Reardon and Merrill[10]
Short-grass prairie	Colorado	Productivity	Stocking rates, grazing exclusion	Milchunas et al.[24]
Short-grass prairie	Colorado	Trend	Stocking rates, grazing exclusion	Hart and Ashby[4]
Coniferous forest	Colorado	Productivity, drought response trend	Stocking rates, grazing exclusion	Johnson,[13,25] Smith[26]
Coniferous forest	Oregon	Productivity, trend	Stocking rates, grazing systems, grazing exclusion	Skovlin et al.[3]
Palouse bunchgrass	Oregon	Productivity, trend	Stocking rates, grazing systems, grazing exclusion	Skovlin et al.[3]
Sagebrush grassland	New Mexico	Trend	Moderate stocking, grazing exclusion	Holechek and Stephenson[27]
Sagebrush grassland	Idaho	Trend	Timed grazing, grazing exclusion	Bork et al.[28]
Sagebrush grassland	Oregon	Drought response	Grazing intensity, grazing exclusion	Ganshopp and Bedell[12]
Chihuahuan Desert	New Mexico	Trend, drought response	Grazing intensities, grazing exclusion	Paulsen and Ares[2]
Chihuahuan Desert	New Mexico	Productivity, trend	Conservative grazing, grazing exclusion	Herbel and Gibbens[5]
Salt Desert	Utah	Trend	Grazing timing, grazing exclusion	Alzerreca-Angelo et al.[29]
Mojave Desert	Utah/Arizona	Trend	Grazing intensity, grazing exclusion	Jeffries and Klopatek[30]

Figure 3. Both perennial grass production and plant survival were higher under light grazing (left) than under long-term grazing exclusion on this pinyon–juniper rangeland in southeastern New Mexico (photo taken in May 2002).

sagewort, slender eriogonum, and broom snakeweed) was higher under exclusion than under grazing. The lower cactus and shrub component under grazing treatments was considered advantageous because those plants are associated with retrogression away from the climax plant community and have low forage value for livestock and wildlife. Light and moderate grazing reduced cool-season graminoids but increased warm-season graminoids (grasses) compared with exclusion. Forb biomass did not differ among grazed and ungrazed treatments. It was concluded that moderate cattle grazing had been sustainable during the 55-year period of study.

In the Chihuahuan Desert of New Mexico, black grama basal cover, over a 37-year period, was maintained at a higher level under conservative grazing (35% use) than under either grazing exclusion or heavier grazing levels[2] (Fig. 1). Black grama is the primary decreaser forage grass (grass that diminishes under heavy grazing) in the Chihuahuan Desert and dominates rangelands in climax condition. Findings from the Paulsen and Ares[2] study are supported by additional follow-up research from the same study areas by Herbel and Gibbens.[5] In contrast tobosa, a perennial increaser grass that grows on bottomland sites, was better maintained under moderate grazing than under conservative grazing, heavy grazing, or protection (Table 3). Tobosa actually had lower basal area under protection than heavy grazing.

Further evidence that managed grazing is sustainable in arid environments is provided by Navarro et al.[6] This study evaluated long-term (1952–1999) trends in ecological condition on 41 grazed sites, well-scattered across Bureau of Land Management rangelands in the Chihuahuan Desert of southern New Mexico. Over the 48-year study period, major changes occurred in rangeland condition due to fluctuation in precipitation. However, at the end of the study, average ecological condition score across sites was the same as at the beginning. The average percentage of cover by primary forage grasses was the same. The authors concluded that managed livestock grazing is sustainable on Chihuahuan Desert rangelands.

Plant Diversity

Very few studies have evaluated the effects of managed grazing on plant diversity in arid and semiarid areas. In the Chihuahuan Desert of south-central New Mexico, Smith et al.[7] reported vegetation diversity was higher on long-term, conservatively grazed, late-seral rangeland than on lightly grazed rangeland in near-climax condition. In another study in the same area, Nelson et al.[8] reported vegetation diversity was the same on moderately grazed, mid-seral, and conservatively grazed, late-seral rangelands. On the short-grass prairie of Colorado, Milchunas et al.[9] found plant diversity increased as grazing intensity decreased. However, the difference in plant diversity between ungrazed and lightly grazed areas was small.

Vegetation Productivity

Long-term managed grazing compared with grazing exclusion, on average, reduced grass production 13% and total vegetation production 4% across 11 different studies (Table 4). The Chihuahuan Desert study by Herbel and Gibbens[5] merits particular consideration because it involved 2 sites and 19 years of data collection. Grazing intensities were conservative (30%–35% average use of forage). On both sites in this study, managed grazing resulted in slightly higher grass production than exclusion. In arid areas, it appears that grazing at conservative levels may have no effect or a stimulative effect on forage production. This, however, needs to be better studied.

Two studies provide evidence that long-term grazing exclusion can result in vegetation stagnation. On chaparral rangeland in south-central Texas, Reardon and Merrill[10] found production of decreaser grasses was lower under grazing exclusion than under a moderately stocked, 4-pasture, deferred-rotation grazing system. On desert shrub rangelands in Nevada, Tueller and Tower[11] found productivity of desirable shrubs (bitterbrush) was lower but productivity of grass-

Table 3. Average basal area of tobosa ($inches^2$) on square-yard quadrats receiving different intensities of cattle grazing in the 1928 to 1943 period on Jornada Experimental Range in southern New Mexico[10]

Grazing intensity	Use of forage (%)	Average basal area of tobosa ($inches^2/yards^2$)
Protected	0	157
Conservative	<40	324
Intermediate (moderate)	40–55	358
Heavy	>55	302

Table 4. Summary of studies evaluating vegetation productivity under controlled grazing and grazing exclusion in North America

			Grass productivity (lbs/acre)			Total vegetation productivity (lbs/acre)		
Reference	Location	Range Type	Grazed	Excluded	Difference (%)	Grazed	Excluded	Difference (%)
Johnston[17]	Alberta, Canada	Northern mixed prairie	1,237	1,446	-14	2,162	2,199	-2
Brand and Goetz[18]	North Dakota	Northern mixed prairie	1,371	1,584	-13	1,562	1,698	-8
Vogel and Van Dyne[20]	Montana	Northern mixed prairie	425	465	-9	583	652	-11
Wood and Blackburn[21]	Texas	Southern mixed prairie	2,920	3,740	-22	–	–	–
Heitschmidt et al.[23]	Texas	Southern mixed prairie	1,025	1,273	-19	1,042	1,282	-19
Reardon and Merrill[10]	Texas	Southern mixed prairie	1,078	903	+14	2,159	1,404	+54
Milchunas et al.[24]	Colorado	Short-grass	632	668	-5	–	–	–
Johnson[25]	Colorado	Coniferous forest	652	1,094	-40	874	1,457	-40
Skovlin et al.[3]	Oregon	Coniferous forest	90	142	-37	249	300	-17
Skovlin et al.[3]	Oregon	Palouse prairie	156	182	-14	333	312	+7
Herbel and Gibbens[5]	New Mexico	Chihuahuan desert	191	183	+4	–	–	–
Average			889	1,062	-13	1,112	1,152	-4

es was higher on grazing excluded compared with grazed areas. This study was not included in Table 3 because quantitative information on grazing intensity was not reported.

Most of the productivity studies in Table 4 apparently did not use cages on grazed areas to calculate herbage removed by livestock. Another problem that we encountered in reviewing the studies is that many of them did not clearly state whether old growth was separated from new growth. In the Herbel and Gibbens[5] study, in which grass production was slightly higher on grazed areas, the authors do state that their estimates involved only current-year growth.

Drought Response

Three studies indicate that light-to-conservative grazing may actually benefit grass plants during drought compared with no grazing.[2,12,13] In eastern Oregon, lightly grazed Idaho fescue and bluebunch wheatgrass had as much and, in some cases, more herbage, seed stalks, and final height than ungrazed plants following severe drought.[12] Similar observations were made for black grama on Chihuahuan Desert rangeland in New Mexico.[2] On coniferous forest rangeland in Colorado, Johnson[13] found moderately and lightly grazed pastures had less reduction in forage production than ungrazed plots during drought.

Figure 4. Forage production has been similar under conservative grazing (left) and long-term grazing exclusion (right) on this ranch in southeastern Arizona. However, native perennial grasses were more prevalent outside the exclosure compared with inside the exclosure where the exotic perennial grass, Lehmann lovegrass, predominated (photo taken in November 2003).

Positive Influences of Managed Grazing

Possible positive influences of managed grazing compared with grazing exclusion on range plant productivity are reviewed by Holechek[14] and Holechek et al.[1] These influences include removal of excess vegetation that may negatively affect net carbohydrate fixation, maintaining an optimal leaf area index, reducing transpiration losses, reducing excess accumulations of standing dead vegetation and mulch, increased tillering in grasses, and reducing apical dominance in shrubs, as well as inoculating plant parts with saliva, which may stimulate growth. Nearly all of the studies identifying these responses were conducted in greenhouses rather than under range conditions. Research by McNaughton[15] in the African Serengeti provides one of the best validations that grazing does have positive or compensating effects on forage plant productivity, whereas Belsky[16] reviews contradictory evidence.

During the past 10 years, we have had the opportunity to evaluate rangeland vegetation responses on several lightly-to-conservatively grazed ranges compared with grazing-excluded sites distributed across New Mexico and Arizona. During this period, severe drought has prevailed. Forage plant survival and productivity have generally been higher on the grazed land compared with grazing-excluded sites (Figs. 2–4). However, the differences were often of small magnitude.

Our conclusion is that, in arid and semiarid areas, grazing can have positive impacts on forage plants compared with exclusion if average long-term use levels do not exceed 40%. However, we acknowledge research supporting this viewpoint is limited. A major challenge for rangeland researchers in the 21st Century will be to provide better information on this subject.

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Guts and Grasses

By Ned Snyder

My interest in ranges and grasses began belatedly after I had owned ranch and farmland in Central Texas for over a decade. Pretty hills, bottomland along the Middle Bosque River, and some productive farmland as well as worn-out fallow fields compose the property. The first decade or so of my ownership was remarkable only in my poor management. I blamed some of my poor performance on a busy medical practice, but complacency is to blame. I had a rural youth, and I had some working knowledge of livestock but not really the land itself. Like many small-town boys of my generation, the land was where one pursued testosterone-enhanced activities, such as hunting, fishing, and working cattle and goats. I did not appreciate the brittleness of my patch of hills and prairie, nor did I appreciate the nature of the responsibility I had assumed when I acquired the property. I guess I resembled the doctor who knows diseases and goes to work every day but does not have a clue about the actual lives of his or her patients.

I am fortunate that there was little mesquite on the land, but it was infested with juniper, and I watched these trees multiply like hamsters. I tried bulldozing, but I only ended up with more rock piles and a new growth of juniper and sumac. The grass was usually ribbon high. A favorite author of mine, John Graves, lives in the same series of limestone hills and says our land is worn out because of "too much cotton and too many cows."[1] Nevertheless, at some point I realized I could do better, and I started to commute to classes of the School of Ranch Management at Texas Christian University. My first class on soil was superb, but the second class on grasses was an epiphany. I began to try to visualize what the landscape really looked like 150 years ago.

Photo 1. Forested area before and 1 year after clearing juniper with a tree terminator.

Moreover, I applied what I learned in class to the ranch. Old fallow fields were planted in native grass mixes, and we used a tree terminator to remove the juniper, followed by distribution of native seed. We began intense rapid rotational grazing and better attention to stocking rates.

I have honestly been surprised that this restoration project has worked so well. I have always considered myself a good fixer of the human body, but many things in the country I previously tried to improve mechanically or agriculturally have not been very successful. An old John Deere 730 diesel rests abandoned on the side of one of my restored fields following my failed attempts to replace a clutch and repair a tangled electrical system. When I bought my first piece of land, there was a recently planted pecan orchard as well as a number of grafted native river-bottom pecan trees. My hopes were high for good income and an orchard of tall trees, and I expended a significant portion of my energy and ranch time the first 3 years on the pecans. While we have had some great pecans for Christmas presents and holiday pies, drought, deer, cows, scab fungus, untimely freezes, weevils, and dishonest harvesters have combined to keep the pecan project from anything close to a commercial success. Therefore, the tall grasses, new water seeps, and high calf weaning weights not only are a surprise but somehow even the score with my pecan losses and equipment failures.

Recently, themes in my medical life as a gastroenterologist repeat themselves in my agricultural avocation. While some have linked grasses to history, I have linked them to health and disease. For instance, one of the more significant maladies we see as gastroenterologists is celiac disease. This is a disease caused by a sensitivity of the small intestine to the gluten component of wheat, barley, and rye. It may occur in a prevalence as high as 1 in 125 people in this country. The damage from the gluten causes the villae in the small bowel to shorten and become blunt, and sometimes even disappear. Consequently, people with significant involvement have diarrhea and malabsorption of necessary nutrients such as iron. The strict withdrawal of gluten-containing foods can lead to complete recovery. Interestingly, celiac disease is almost exclusively a disease of descendants of peoples who were wheat eaters. While Europeans and North Africans used wheat as their primary cereal/bread, Asians had rice, and Mesoamericans had corn or maize. Teleologically, celiac disease must have provided a survival advantage to its victims. In a manner analogous to sickle cell anemia, which protected those inflicted from the ravages of malaria, I suspect celiac disease may have provided some protection from parasites like *Giardia lamblia* and hookworm and/or bacterial pathogens such as cholera.

While celiac disease is a problem in a sense caused by grasses, it also reminds me of what happens to the land when grasses are inadequate. Instead of the tall grasses catching and filtering the rain and adding it to the soil and springs and aquifers, there is basically malabsorption and diarrhea with the water sluicing and slithering away with resultant erosion and dry creeks. Grasses are like our villae, and if they are shortened or absent, the land has a problem.

My research interests concern fibrosis or scarring in the liver. When the liver is injured by long-term alcohol use or diseases such as chronic hepatitis C, scar tissue or fibrosis develops as a response to the chronic inflammation. This leads to an interference with the flow of blood from the portal venous system, which brings blood from the digestive tract to liver. The portal vein and its tributaries carry the products of digestion to the liver, where they are altered and metabolized for further use or excretion. If one has cirrhosis (which is advanced fibrosis), much of the portal blood is shunted around the liver in collateral blood vessels and denied that first, beneficial passage through the liver. Most of the complications of cirrhosis relate to this shunting process, which is known as portal hypertension. I actually think of portal hypertension whenever I see a large stand of juniper combined with an eroded grassless gully swirling with brown water after a rain. In a manner analogous to what happens in the diseased liver, the water bypasses absorption by the soil and wastefully is shunted with its stolen topsoil and nutrients to creeks that function like the collateral blood vessels.

The consequences of abusive practices are a common theme in both my ranching and my medical life. My medical work often deals with patients with liver disease from alcohol or chronic hepatitis C, which frequently results from past drug abuse. We are also finding a specific type of liver disease called nonalcoholic fatty liver disease among the obese. While the previous marginal lands that were plowed and planted and the pastures that were overgrazed were done so innocently, the resultant short inferior grasses and fallow infertile fields are a consequence of a relative abuse. Better grazing techniques, reseeding of pastures, and removal of juniper and mesquite with the resultant growth of medium and tall grasses can partially heal diseased land. We do not do as well with sick livers, but we are beginning to find ways to halt and perhaps improve fibrosis, and of course we have liver transplants for some of the lucky failures.

An area that medicine and at least some range enthusiasts may disagree about is in regard to the use of nonindigenous plants or parts. In medicine, we do not hesitate to replace worn-out heart valves or abused hips with metal prosthetic parts. We also freely take antihypertensives and statin medications to alter the blood pressure and cholesterol that our genetics and lifestyle have presented us. On the other hand, introduced grass and plant species in general have been more of a problem than benefit, and in my own experience, native grasses like Indian grass, little and big bluestem, switchgrass, and side-oats grama are the best bets in our area. Klein grass (*Panicum coloratum* L.) was planted on my place before I began the restoration, and we have included it in the seed mix that has been thrown on the reclaimed areas. Its deep roots have served it well through the hot summers, and I am very fond of it. While purists may frown, I find it a benefi-

Photo 2. Hillside after clearing with a tree terminator and 1 year later.

cial nonnative addition, just like new hips and pharmaceutically restored low cholesterol counts.

"Holistic" is a term that has been used frequently in the past decade to relate to practices in both medicine and land management. After a discussion of Allen Savory's theories in my grasses class, I obtained a copy of his book *Holistic Management*.[2] Subsequently, I have learned that holism is a philosophical concept termed by J. C. Smuts in 1926 to mean the entirety of an organism and that it implies a teleological purpose that cannot be explained by laws governing its separate parts.[3] While holism when applied to the human species has come to be synonymous with humanistic and psychosocial approaches to health care, it has been further trivialized to a code word for alternative and nonscientifically proven forms of medicine.[4] So it actually took my grasses class and books on land management for me to realize the true meaning of a phrase commonly used in medicine. I like the actual meaning of "holism" much better.

I know this sounds trite, but the healing of the land and the body have much in common. Smuts's ideas about the whole being greater than the sum of the parts and the concept of no boundaries can be applied to the health of both the land and the human body. Perhaps the disciplines of medicine and range management can learn from one another.

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Keep an Eye on Your Keys

By Matt Mattox

Losing your keys can put a damper on the beginning of a beautiful day. If you've simply misplaced them but know they're around somewhere, the worst that usually happens is you have to put other things on hold and locate them. If the search reveals that you have truly lost your keys, the next step is to get some new keys made. Frustration, wasted time, and an outlay of cash for a new set of keys are extra annoyances when this happens.

Did you ever imagine the same thing happening with your pastures? Think about it: if you run livestock on rangeland, what happens when key forage species get overgrazed? Gradually, livestock will selectively graze out the key species, and before you know it, forbs or less desirable species have replaced the good stuff and left you wondering what happened to your "keys."

If you recognize this problem early, it's possible to adjust the stocking rate and/or grazing management to sustain the key species and maintain or gradually increase pasture productivity. Failing to recognize this situation—or recognizing it but not adjusting grazing management—often leads to frustration, finger-pointing at the weather man, and, for the impatient, thoughts of converting native grass to bermudagrass or the latest wonder grass on the market—in effect, making new keys.

Many times with tame pasture, such as bermudagrass, we suggest stocking rates based on the total amount of expected production, combined with the level of utilization that we think corresponds to a producer's grazing management skills and that also will sustain plant vigor. For an experienced producer in the southern Great Plains with a fertilized stand of bermudagrass that will yield an estimated 2.5 tons of forage per growing season, we might suggest a seasonal stocking rate based on grazing 70% of the grass he grows over a 7-month period. In this case, the stocking rate would be 1.8 acres per 1,100-pound cow. We often suggest stocking rates on native grass in the same manner, but if we are not conservative in doing so or if the producer does not monitor his pastures, this method can lead to "losing your keys." So, while we may stock based on utilizing 25% on *native grass,* the knowledge of and use of key forage species as a management tool enables us to adjust stocking rates in order to keep desirable forages and avoid reducing the productivity of native grass pastures.

To determine your key forage species, you have to know your major plants and a little about what livestock like to eat. Key forage species are normally perennial plants. They should be well distributed and provide a significant proportion of the plant composition in a pasture. They should also be relatively well preferred by the livestock species you are managing. This is where knowing what livestock like to eat proves valuable. About 15 years ago, Jack Cutshall and I were kicking around on a ranch in central Louisiana when he asked me, "If you had the choice of eating a steak or a hot dog, which would you eat?" It was close to dinner, so I said, "I'd eat my steak first, and then if I was still hungry, I'd eat the hot dog." He asked, "Then why do you think the cattle are hammering the Indiangrass in this pasture?" Before I could reply, he said, "The cattle figure they don't know how long they'll be in this pasture, so they're eating their steak first, too!" His message to me was that cattle have preferences for different plants just like people have preferences for different foods. The cattle preferred the Indiangrass over the rest of the forages in the pasture and therefore ate a higher percentage of it than the other forages.

In this case, Indiangrass was the key species, and if grazing management were not addressed, the abundance of this

Photo 1. Left to right: Indiangrass, oldfield threeawn, and silver bluestem.

important plant would be reduced, and it would be gradually replaced by less desirable species, which most likely would reduce the carrying capacity of the pasture. The picture depicts 3 native grasses: Indiangrass, oldfield threeawn, and silver bluestem. If you had a pasture containing all these plants, it is highly likely that cattle will apply the "steak/hot dog principle" when grazing these plants. *Most often,* cattle will prefer Indiangrass over silver bluestem and silver bluestem over oldfield threeawn. There are times, such as early spring, when all these forages are selected, and it's harder to discern grazing preferences. However, as the growing season progresses, you will almost always see the Indiangrass grazed harder than the other 2 grasses by cattle. If Indiangrass were abundant enough and distributed fairly well in this pasture, we would consider it the key species.

Now go back to the discussion on stocking native grass pastures based on a percentage of grass utilization. If we stocked this pasture based on 35% utilization and had enough information to tell us that this pasture should produce 3,000 pounds over a year's time, the suggested yearlong stocking rate would be about 10 acres per 1,100-pound cow. But if we don't monitor the grazing use of key species, cattle may overgraze the Indiangrass, resulting in underuse of the other grasses. With no attention paid to this matter over several years, the composition of plants in the pasture will likely shift to the point that Indiangrass is no longer abundant enough to be considered a key species. Forbs or less desirable grasses replace Indiangrass, and pasture production is reduced. To alleviate this problem, allow the livestock to graze no more than 50% of the key species. By not overgrazing the key species, remaining forages are much less likely to be overgrazed, and pasture productivity is easier to sustain. It's easier to talk about using no more than 50% of a particular grass than it is to do it. Obviously, this will take some monitoring, or "looking for your keys." The most practical method of doing this is to locate a key area in every pasture. A key area obviously contains the key species, has a high amount of available forage, and has average topography relative to the whole pasture, and the grazing distribution of livestock is not biased by distance to water (too close or too far). A key area should also not be close to feeders, mineral or salting locations, or the lone grove of shade trees in the pasture.

It's not hard to find a key area in each native grass pasture, but you need to get out of the pickup and walk through the area in order to determine the grazing use of the key species. You will get a different perspective looking down on the grass than you will looking across the grass.

The concept of key species and key areas is not new to the range profession. However, it's hard for me to think of a more proven, producer-friendly, grazing management tool. It is also one of the easiest monitoring methods available. Ranchers spend a lot of time on their land—use it wisely by learning your plants and utilizing this simple method. Also, it's probably not a bad idea to keep another set of keys in the barn.

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Old West Meets New West: A Story of Modern Cowboys and Native Americans in the Northwest

By Laura Gow

Harney County, Oregon, ranks ninth among counties in the United States for beef cattle production with nearly half of the county taxes realized from the ranching community.[1] Harney County is also the ninth largest county in the United States (10,200 square miles) and is larger than 8 states.

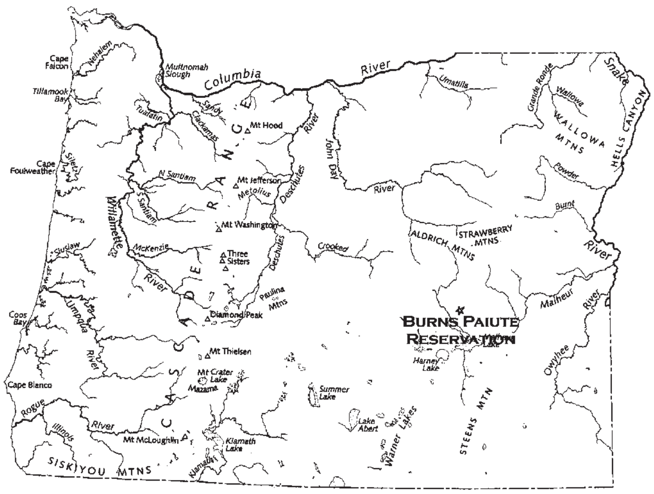
Located in southeast Oregon at the northern edge of the Great Basin, the climate of the area is characterized by extremes in temperature with bitterly cold winters, hot summer days, and broad daily temperature fluctuations (often more than 50° a day). The frost-free growing season is usually less than 60 consecutive days. Precipitation averages 8–14 inches in the lowlands and 14–40 inches in the uplands.[2]

Photo 1. High-desert rangelands in Harney County, Oregon.

Harney County is not unlike many rural counties in America today that are experiencing population out-migration, high unemployment, resource conflicts, and a lack of industry. Oregon Employment Department (2004) statistics indicate the government is the largest employer in the county, with approximately one-third of all jobs, and agriculture accounting for approximately 25% of all jobs.[3] In 2003, the annual unemployment rate averaged 11.3% and roughly 7% of job seekers left the county in search of better employment opportunities.[3] Also in Harney County, located just north of Burns, Oregon, is the Burns Paiute Tribe. Today there are almost 300 enrolled tribal members, but less than 37% reside permanently on the reservation. Due to the economic conditions and the remoteness of the county, identifying economic activities and employment-generating opportunities have been a constant priority for the tribe.[4]

Cowboys and Native Americans

The tribe had already established a successful casino and campground in the area, so given the resources of the area and the strong local cattle economy, a logical option for the tribe to consider was cattle production. While livestock production is not new to the Native American culture, cattle production can be considered a relative newcomer to the Native American economy. Several tribes have very well organized grazing permit programs for tribal lands that are available to both individual tribe members as well as nontribal ranchers. Throughout the West, Native Americans have been involved in raising sheep and goats, and many Northwest tribes, such as the Nez Perce, the Palouse, and the Cayuse, were known for horse breeding and trading from as early as the 1700s and actively managed large herds of horses grazing throughout the Northwest. However, very few tribes have been actively involved in the direct ownership of



Map 1. Location of Burns Paiute Tribe. Map image from the Atlas of Oregon (2nd Ed.), copyright 2001 University of Oregon Press.

cattle, and the management of cattle can be considered a relatively new enterprise for tribes. Looking at their tribal neighbors to the north, they found some interesting results.

The Umatilla Confederated Tribes (UCT) located to the north of the Burns Paiute Tribe had seen tremendous economic growth and success from their casino, RV park, hotel, and golf course and began looking toward cattle as a way to expand and diversify their economic base. The UCT's approach to entering into the cattle industry was a unique and controversial one that brought much attention from the cattleman in Oregon. Umatilla's approach was to assert treaty-grazing rights on federal grazing lands, which was something no other tribe at the time had done.

The basis for UCT's approach had deep-seated historical roots, stemming back to an 1855 treaty that the U.S. government signed with each of the tribes of the UCT (Umatilla, Cayuse, and Walla Walla). The conditions of the treaty were such that the tribe ceded 6.4 million acres of their homeland to the U.S. government but retained the right to hunt, fish, gather berries and other vegetation, and graze livestock. Specifically, the treaty stated that "the privilege of hunting, gathering roots and berries and pasturing their stock on unclaimed lands in common with citizens, is also secured to (said Indians)."[5]

In the 21st century, the tribe decided to act on this right by using U.S. Forest Service land in the Blue Mountains of eastern Oregon for summer grazing. However, the Oregon Cattleman's Association (OCA) argued that this definition did not apply to federal grazing lands, as federal grazing permits excluded others from the right to use those lands just as a private purchase or private lease would exclude others from joint use of the land. Therefore, these lands were not considered "unclaimed lands."

Controversy ran amok throughout the cattle producers in the state based on the definition of "unclaimed lands." The OCA asserted that federal permit holders own the grass on federal lands and that it was a property right that could not be taken away and as such could not be considered unclaimed lands. The ranchers in the state did not want to exclude the UCT from using those lands, but they did not want to see the Native Americans receiving preferential treatment to grazing allotments. However, at the same time, the federal government did not dispute that the tribe retained their grazing rights through the 1855 treaty.

These disputes over returning grazing rights to the UCT had left a bad taste in many people's mouths throughout the state. The Burns Paiute Tribe decided they would investigate the feasibility of a tribe cattle operation based on their existing lands and did not want to follow the path that the Umatilla tribes had followed.

The Old West

The U.S. government's policy on the management and dissemination of Native American lands has varied throughout history. This has resulted in a variety of types of Native American landownership: tribal, individual Native American, as well as a mix of trust and fee lands. Trust lands are lands in which the title is held in trust and protected by the federal government. The tribe or individual Native American has use of the land, but ultimate control of the land remains with the federal government. The term "fee" is a legal term that refers to someone being in absolute and legal possession of property and does not refer to a payment for use. This pattern of landownership is commonly referred to as checkerboarding and can affect the ability of tribes or individual tribal members to use the land for farming, for ranching, as a home site, or for development.

Since the mid-1800s, the U.S. policy regarding the allocation of Native American land has been an evolving process. Initially, the prevailing policy was to segregate lands for the exclusive use and control of Native American tribes (ie, reservations). This policy has given way to the idea of allotting land to individual Native Americans. These parcels, or allotments, were held in trust by the government for no less than 25 years with the intent of eventually turning over complete ownership and control of the land to the individual Native American. After the 25 years had passed and the secretary of the interior was satisfied that an allottee was competent and capable of managing his or her affairs, the government would issue a fee patent (title). A fee patent typically coveys title of the land to the Native American from the U.S. government. Prior to that, a Native American could not sell, transfer, or enter into a contract for the sale or transfer of that land.

However, this policy of allotment came to an end in 1934 when Congress halted further allotments to individual Native Americans and extended indefinitely the existing periods of trust for allotment lands that had not been issued fee patents. The policy was then to return unallotted surplus Native American lands to tribal ownership or to be held in trust for the tribes. As a result of this changing government policy, there are a variety of ways in which we see Native American lands being owned today. Native American land may be owned by land held in trust for tribes as reservations, land allotted to individual Native Americans that is still held in trust by the federal government, land originally allotted to individual Native Americans who now hold title to the land, nontribal members who have acquired land from Native Americans who hold title to the land, and land owned by individual Native Americans or tribes outside of reservation boundaries and acquired from non–Native Americans.

The Burns Paiute had lived on the Malheur Reservation, which consisted of approximately 1.7 million acres in southeast Oregon. The reservation was reserved for all bands of Native Americans that were still "wandering" or living semi-nomadic lifestyles at the time. The Burns Paiute were part of one such tribe, the Northern Paiutes. The Northern Paiute Tribe was made up of small, peaceful bands that roamed throughout central and eastern Oregon prior to settlement in the late 1800s. In 1883, the government converted the reservation to public domain, which opened the land for white settlers to claim under the Homestead Act. At this time, the federal government allotted 160-acre parcels to individual Native Americans who had lived on the Malheur Reservations. These allotments were located in what is today Harney County.

Only 115 allotments were given to the Burns Paiute tribe even though many more individuals were eligible to receive an allotment. Distrust and fear of the government led many tribal members to believe that this was some sort of a trick. Consequently, many Native American families camped near the towns of Burns and Drewsey and found seasonal work with ranches.

Today, the Burns Paiute Tribe has acquired several thousand additional acres outside the reservation to manage for conservation and ranching purposes. In the past decade, they have acquired a 6,450-acre cattle ranch on the Malheur River and a 1,760-acre ranch in Logan Valley. The tribe was able to acquire these ranch lands through funds provided by the Bonneville Power Administration (BPA) wildlife mitigation program. The BPA uses funds directed by Congress to compensate the public for wildlife habitat lost when dams were built on the Columbia River in the early 1900s.

The tribe proposed extensive wildlife mitigation, vegetation, and riparian projects on these properties and worked closely with an advisory group consisting of federal and state agencies, private organizations, and community members to develop a comprehensive management plan. The tribe's ongoing management objectives for these acres are to maintain sustainable levels of cattle production; repair riparian areas; control weeds; improve habitat for elk, deer, antelope, marmot, and sage grouse; and protect historical cultural sites left by the tribe's ancestors.

Photo 2. Pasture land in Harney County, Oregon. Source: Eastern Oregon Agricultural Research Center, Burns Station.

The Burns Paiute Tribe also has reservation land that covers 930 acres of trust land, 320 acres of fee-patent land, and another 11,000 plus acres of allotted lands held in trust for individual tribal members.

Got Beef?

So the question remained whether the tribe could feasibly operate a tribally owned and operated cattle operation. What opportunities would there be for a tribal cattle operation? Could they create a niche for their product? Would it be possible to integrate the various lands held by the tribe and individual tribal members to provide for adequate haying and grazing resources for a herd of cattle?

In Harney County, the government owns 76% of the land, which makes for a relatively limited supply of private land available for any use.[2] To be successful in raising cattle in the high desert of Oregon, it essential that one have access to adequate rangelands for grazing. Therefore, in Harney County, grazing typically relies on obtaining a government allotment from the Bureau of Land Management, the U.S. Forest Service, or Oregon State Land (ie, grazing permit) or purchasing or leasing some of the limited supply of private land. As in most western states, grazing allotments are in limited supply and often very difficult to come by, and access to private land can be limited. Therefore, entering into ranching or expanding grazing activities for the general population of Harney County can often be very difficult.

The Burns Paiute Tribe had several forage resources available to utilize in a cow–calf operation. These forage resources include native rangelands as well as irrigated and nonirrigated hay ground. With a well-devised management plan that would include feeding of grass, feeding of alfalfa hay, and grazing of pasture and rangelands, the tribe could successfully operate a 250–350-head cow–calf operation. For Harney County, a 250–350-head operation would be considered relatively small and not a large generator of economic activity by itself. It is relatively easy to run 250–350 with a few key employees and a few seasonal employees. However, it does not create a lot of employment opportunities for the tribe and the county. So the larger question for the tribe still remains. What could they do with their available resources that would provide economic activities and generate employment?

Many successful cow–calf operations have turned to the idea of vertical integration for long-term success in the cattle industry. The term "vertical integration" refers to producers owning or controlling the activities that are ahead or behind them in the total production process. In agriculture, this includes all the activities involved in bringing a product from the farmgate to the consumer plate. In the case of the tribe, they could consider stocking or backgrounding activities, retaining ownership of animals, finishing animals, and small-scale slaughter and processing. In addition, other employment-generating activities that could be considered would be expanding the operation, diversifying the operation into sheep or goats, establishing a purebred component to the operation, and an artificial insemination breeding program.

Into the New West

Coupled with these activities, the tribe could also consider niche marketing their beef products under a tribal brand. Niche marketing targets a subset of consumers who are not being readily served by the traditional products in the market. Niche marketing focuses on specialty products that are designed to be marketed to a very well defined set of consumers. Low profitability in the beef industry along with changes in consumer tastes and preferences have led many small producers to consider niche markets for their products. Niche marketing generally results in higher production costs but also usually sees higher returns over conventional marketing alternatives.

Recently, there have been several successful niche-marketing programs with natural beef products. The U.S. Department of Agriculture defines a natural product as one that contains no artificial or added color and is only minimally processed (ground, frozen, or smoked). In addition, the product must explain the use of the term "natural," such as "no added colorings" or "no artificial ingredients." Many natural beef products promote their products on the basis of the lack of hormone and subtherapeutic (fed) antibiotic use and animals being grass fed. The nature of this cattle enterprise could provide just such an opportunity to market their product as an all-natural Native American product.

More and more tribes are beginning to look at their identity as a source of marketing power. They are beginning to realize, as more and more niche markets develop for natural products, that there is the possibility of using Native American branding and labeling of products as a means to differentiate their products in the market. Labeling of Native American products can focus on many of the positive stereotypes associated with the ways of the Native American and western culture. It can focus on Native Americans' strong beliefs and respect of nature as a cornerstone to the marketing of their products. Many consumers consider the Native American culture to exemplify the natural lifestyle they desire. This image could go a long way in the marketing of a Native American natural beef product. This could provide an excellent opportunity to market not only a natural beef product that was born, raised, and slaughtered in the United States but also one that was done by the original environmental stewards who know what conservation is all about.

Today, the economy of the Burns Paiute Tribe still remains closely tied to the economic activities of Harney County, which are centered primarily around agriculture production, the lumber industry and government services. Some tribal members are employed in these industries, but unemployment on and off the reservation still remains high.[6] The tribe still continues to investigate the feasibility of alternatives for employment-generating activities and economic development projects and works closely with local and county governments. In recent years, they have worked on a distribution center, bottled water processing, and casino-related activities and have upgraded facilities on the reservation. In 2004, the tribe also applied to form a corporation to better compete for federal contracts. Currently, they are focusing on taking over the management of a state archive center and expanding the services provided in this data warehouse. Value-added and niche marketing activities will be something they continue to investigate in the future.

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Using Stubble Height to Monitor Riparian Vegetation

A Team of Experts Concludes That Some Past Uses Have Been Inappropriate.

By The Stubble Height Review Team

In late 2003 and early 2004, a team of experts, consisting of individuals experienced in monitoring, management, and/or research on riparian areas, was assembled to study the use of stubble height as a standard for livestock grazing effects upon riparian-dependant resources. The Team was asked to evaluate current uses of stubble height by federal land management agencies in the Pacific Northwest and to compare those uses to its limitations and assumptions in the scientific literature. This article summarizes the Team's findings.

Riparian vegetation plays a critical role in stream function and the development of streamside and in-stream characteristics beneficial to aquatic species.[1–6] Livestock typically impact stream condition either indirectly by altering vegetative condition (vigor or community composition) or directly through mechanical disturbance of stream banks. In recent years, measures of vegetation stubble height remaining after the grazing period have been used to indicate the degree to which plants were grazed in a given season and as an index of grazing effect on riparian functions, including streamside and in-stream characteristics.


A well-vegetated stream bank.

Stubble (vegetation height) has been shown to be a good indicator of 2 primary factors: 1) the effect of grazing on the physiological health of the individual plant, and 2) the ability of the vegetation to provide stream-bank protection and to filter out and trap sediments from overbank flows.

A summary of the literature showed how stubble height remaining after grazing can be, in addition to the above indicators, an indirect indicator of stream-bank trampling and shrub (willow) browsing on the stream banks. Clary and Leininger[7] proposed a 10-cm residual stubble height criterion as a "starting point for improved riparian grazing management." However, they acknowledged that, in some instances, 7 cm may provide adequate riparian protection and that, in others, 15 to 20 cm may be required to limit stream-bank trampling or to reduce willow browsing. Thus, the criteria could vary depending upon local environmental variables and the timing, duration, and intensity of livestock use. Unfortunately, the linkages between stubble height and riparian functions have had limited experimental examination. For this reason, stubble height as an annual indicator of grazing use in riparian areas should only be used where existing science suggests that it is appropriate and should be used in combination with longer-term monitoring of vegetation and channel parameters. This article shows where stubble height indicators and criteria can and should be used in riparian

Stubble Height Can Be Used as an Annual Indicator of Livestock Utilization Effects on Stream/Riparian Areas

- Associated with perennial streams or intermittent streams that support hydric vegetation on the greenline
- Near the stream edge or along the stream margins—commonly at the first perennial vegetation above the water line
- In areas of hydrophilic or potential hydrophilic vegetation—wet areas adjacent to the stream; NOT in dry vegetation types at the tops of stream banks above the influence of water in the rooting zone; depositional banks are more favorable to hydric vegetation; erosional banks whose tops are above the bank-full level are not favorable to hydric vegetation
- Where herbaceous vegetation is dominant along the stream edge and controls stream bank stability; stubble height does NOT apply where woody vegetation and/or rock control bank stability

  Where these environmental conditions do not occur, direct monitoring of shrub browsing or stream-bank disturbance, rather than stubble height, will be necessary to assess annual livestock grazing impacts.

management. If riparian conditions are not meeting resource objectives, are degraded and static, or in a downward trend due to livestock grazing, changes in management should be implemented and monitoring of the riparian responses should be required. An "adaptive management" approach is recommended to refine the grazing strategy through time, as needed, to meet the long-term riparian resource objectives.

Appropriate Use of Stubble Height

Environmental Constraints

The use of stubble height is restricted to sites near the stream edge, that is, areas that can be described as streamside, or near-stream, typically represented by hydrophilic (water-loving) or potentially hydrophilic vegetation.[7] At this interface between vegetation and water (the green line), riparian and stream habitats are most sensitive and dynamic. This is where moist vegetation communities are mostly likely to occur and where the erosive energy of the stream plays a major role, affecting both the riparian vegetation and channel form. Because hydrophilic vegetation is often heavily rooted, with creeping underground stems (Rhizomatous), and tends to form complete bank cover along the channel margins, it can be very resistant to stream erosion. This resistance lends itself to channel stability and helps to create stream habitat structure and complexity favorable to aquatic organisms. It is here where stubble heights must be measured to assess hydrophilic plant vigor, which, in turn, reflects plant influences upon stream bank and channel stability. Because stubble height applies only to herbaceous vegetation, its use applies only where herbaceous vegetation currently controls bank stability (Sidebar 1).

Sampling Constraints

Stubble height sampling is quick, simple, and reasonably accurate. It can be used to monitor large areas in less time than is needed with traditional utilization study protocols. In some situations, however, accuracy can be adversely affected by stand characteristics. Difficulties with stubble height arise, for example, in irregularly grazed bunch grasses or stands of inconsistent plant composition with varying palatability. For these reasons, stubble height measurements should focus on key riparian plant species or species groups important to bank stability. Stubble height monitoring should report the average use by similar key species, not integrated across all available species. Because plants have varying growth height potential, averaging stubble height across multiple, dissimilar species can skew the results in favor of taller or shorter growing species that predominate in a sample area. Grouping the data should only be done among species with relatively similar growth forms.

Stubble height measurements should be derived from a population of samples statistically adequate to reflect actual grazing use. The selection of species groups, where appropriate, may reduce the total sampling requirements or may increase precision within a given sample number. The selection of monitoring sites (Designated Monitoring Areas, [DMAs]) should be based on the endpoint indicator being

Stubble Height Can Be Used as an Annual Indicator of Livestock Grazing in Riparian Areas

- Where it is applied to individual key species or community types used by livestock, which also play an important role in maintaining stream-bank stability
- Where it is statistically applied to individual key species or to groups of species with similar growth characteristics
- Where enough observations are collected to reflect grazing use variability across the extent of the monitoring area. A sequential sampling method, such as Turner and Clary[9] has the advantage of being rapid, avoiding skewness, and providing statistically accurate answers

  The monitoring site(s) (DMAs) must reflect management impacts on all major riparian cover types of the stream/riparian area within the pasture, be representative of overall grazing use within the entire riparian area of the pasture, and occur only where livestock are using the riparian area. The DMA should not be located where the vegetation community type is not an important contributor to stream function or where cattle concentrate (eg, stream crossings). The DMA should include stream segment(s) critical to important riparian-dependant resources (eg, spawning and early rearing segments).

monitored. They should be representative of grazing use specific to the riparian area being assessed and should reflect what is happening in the overall riparian area as a result of on-the-ground management actions (Sidebar 2).

Process for Adaptive Management

Although stubble height is easy to use, it is not a resource objective and therefore inappropriate as a prescriptive standard in grazing permits and land use plans.[7,8] It should be used as a guideline or indicator for changing annual management in the Annual Operating Instructions/Plan. Because it is an estimate of the amount of livestock use, it can be used to control how much use takes place within the riparian zone of a grazing unit in any given year. As such, it is often used in the annual operating plan as a "trigger" for when livestock should be moved from the grazing unit. However, such a "trigger" needs to be validated to ensure that it actually achieves desired riparian resource objectives within a reasonable time frame.

Stubble height, stream-bank disturbance, and woody-stem use are all short-term indicators of grazing use and may or may not reflect the meeting of long-term riparian management objectives such as the composition of desirable hydric green-line vegetation or stream-bank stability. Each short-term indicator, like stubble height, can be used in the appropriate situation, as criteria for achieving desired grazing-use levels in the annual operating plan. To properly manage the grazing operation, the current condition and trend of the long-term riparian management objectives would be compared with the desired condition of those objectives to assess the need to adjust grazing use. The land manager and grazing operator would work to make adjustments, as needed, to meet the long-term riparian management objectives. The permit standard for compliance would then be based upon the operators' demonstrated effort to meet those adjustments. The Allotment Management Plan would have, as its long-range objective, the requirement to achieve the desired long-term riparian management objectives within a reasonable time frame. Such a time frame would be approximated by the near-natural rate of recovery, taking into account year-to-year variability in environmental processes that control recovery. Under this approach, it would be inappropriate to use stubble height numeric values as the sole means to manage toward achieving the long-term riparian management objectives.

Users should modify the wording in permits and Land Use Plans to use stubble height criteria, not as a compliance standard, but as 1) a "trigger" to assess when livestock should be moved from a grazing unit, and/or 2) an annual "prompt" to investigate and assess the riparian resource condition and to help inform decisions concerning the need to make appropriate changes in annual management. If stubble height at the end of the growing season indicates that the grazing management is not achieving use levels compatible with desired riparian resource objectives, then identify appropriate and timely action to correct the root cause. This would be accomplished through adaptive management.

Steps in the Adaptive Management Process

I. Define the resource objectives (riparian management objectives).
II. Develop a grazing plan to accomplish the objectives.
III. Identify trigger and endpoint indicators and the numeric criteria for these monitoring indicators used to assess success.
IV. Implement the grazing plan and monitor the indicators.
V. Annually evaluate the success of the grazing plan.

Adaptive management is an interdisciplinary planning and implementation process that identifies desired riparian conditions, defines criteria for modifying grazing operations when progress toward achieving the desired conditions is not being made, and specifically defines the monitoring strategy and protocols. Monitoring can determine whether the project-level decision is being implemented as planned (implementation monitoring) and, if so, whether the objectives are being achieved in a timely manner (effectiveness monitoring). The process invites participation from rangeland users and other interested parties, where feasible. The following summarizes the process of adaptive management (Sidebar 3).

Step I. Determining riparian resource objectives is defining the goals for the riparian/aquatic communities at the pasture scale. Because livestock grazing primarily influences the status of riparian vegetation along the stream margins, stream bank stability, and woody species regeneration, the objectives often focus on these 3 resource characteristics. Objectives for riparian vegetation status and bank stability are normally quantitative, and qualitative for woody species regeneration.

Step II. Developing a grazing resource plan means designing a plan to achieve the riparian resource objectives within a reasonable period of time. The plan should be at the pasture and allotment scale and identify timing, intensity, and duration of use expected to achieve the desired objectives.

Step III. Identifying the monitoring indicators pinpoints the markers used to gauge success of the Grazing Plan. *Trigger monitoring* is used to determine when livestock should be relocated from an area or pasture to achieve desired use levels. It is the responsibility of grazing permittees and herd managers to achieve the desired grazing use levels. Stubble height measures trigger answers to key questions: ie, "Is it time to either ride harder to keep cows in the uplands away from the creek or move them to another area of the pasture or even completely remove them from the pasture?" Such "triggers" are used by permittees as indicators of allowable use in a given riparian area and are designed to limit livestock impacts on riparian vegetation and disturbance of stream banks. Site variability ensures that a single trigger (eg, stubble height value), will not be appropriate in all situations.

Other use indicators may also be appropriate in "trigger" monitoring. An Interdisciplinary Team might select 3 triggers (eg, stubble height, bank disturbance, level of use on woody plants) to start with and as they gain experience find that only

1 or 2 are needed. When any 1 of the selected triggers is reached first, the permittee should take appropriate action.

Endpoint indicators are the responsibility of agencies in assessing resource impacts of the current year's grazing. However, grazing permittees and, where there are Endangered Species Act (ESA)-listed species, the consulting agencies should be involved in the annual grazing assessment. The appropriate time to measure and evaluate endpoint indicators is typically between the end of the growing season after livestock grazing has been terminated and before the next high-flow event that will reach or exceed bank-full stream-flow levels. The purpose of the assessment is to determine if the actual grazing use in the current year's grazing season left the stream and associated riparian area in a condition likely to result in a desired trend toward meeting the long-term riparian management objectives. Most appropriate endpoint indicators for stream/riparian areas center on vegetation (herbaceous and/or woody riparian species) for protection and building of stream banks and on amounts of mechanical disturbance leaving stream banks vulnerable to increased erosive energies experienced during high flows. The primary purpose is to assess the condition of the stream/riparian area before the next high stream-flow event or annual flood, when bank erosion is most likely to occur.

It is a relatively common practice to factor in expected regrowth when setting within-season triggers for vegetation, particularly herbaceous stubble height. In these cases, end-of-season monitoring is of critical importance to evaluate the appropriateness of the regrowth factor. All too often, expected regrowth does not materialize, either because of lower-than-expected precipitation or overly optimistic estimates of the actual length of the growing season. The critical point for discussing the criteria for triggers is at the end of the growing season when the results are apparent.

When using both within-season triggers and endpoint indicators, allowable numeric values must be established. The monitoring strategy must not only measure and evaluate whether or not the allowable numeric value is met but also whether the value is correct. Because of site-specific differences across the landscape, the determination of allowable numeric values must rely to a large part on professional judgment. Current research can give the manager a starting point but may not be precise enough to apply in a "cookbook fashion." One approach is to begin with default values in current applicable research, then factor in site-specific characteristics to arrive at a reasonable allowable numeric value. The initial allowable resource value is estimated and subject to refinement through time. This reinforces the value of adaptive management. At each stage of the monitoring cycle, ie, within-season trigger, endpoint indicator, and short-term, midterm, and long-term evaluations, assessments must include whether triggers, endpoint indicators, and associated allowable numeric values are useful in driving adjustments to management that lead to desired improvements in riparian and aquatic habitat conditions. In other words, the manager will be continuously seeking to refine triggers, endpoint indicators, and management to achieve the desired results.

A riparian site that would not benefit from residual stubble height because it is dominated by woody vegetation.

A riparian stream bank that would benefit from residual vegetation stubble.

Step IV. Implementing the monitoring plan should follow established monitoring protocols. The plan should be included as part of the Grazing Plan and be updated through time as new monitoring information becomes available. If, for example, the monitoring data suggest that stubble height does not trigger the need to relocate livestock before allowable levels of bank disturbance are reached, stubble height monitoring might be eliminated or reduced in intensity.

Step V. Evaluating success annually of the grazing plan is carried out by the interdisciplinary team (ID Team) that assesses compliance with the management criteria and, in cases where the criteria were not met (including the end-of-season use criteria), the ID Team makes recommendations for changes to the grazing plan. The ID Team will use input from the Level 1 Team where ESA is relevant to noncompliance. The line manager then meets with the permittee to adjust the annual grazing plan accordingly. Where the grazing operation was not in compliance with any portion of the

Table 1. Timing, responsibility, and participation in the Adaptive Management Process for livestock management in riparian areas.			
Action	**Timing and frequency**	**Responsibility**	**Participants**
I. Set Riparian Objectives	During planning phase	Action agency	Permittees and consulting agencies
II. Develop the Grazing Plan	During planning phase	Action agency	Permittees and consulting agencies
IIIa. Selection of TRIGGER INDICATORS	Planning and potentially after annual management evaluations	Permittees and action agency	Consulting agencies
IIIb. Selection of ENDPOINT INDICATORS	Planning phase, or potentially after periodic evaluations	Action agency	Permittees and consulting agencies
IIIc. Selection of Long-Term Monitoring Indicators to assess meeting RIPARIAN OBJECTIVES	Planning phase, or after RIPARIAN OBJECTIVE evaluations	Action agency	Permittees and consulting agencies
IIId. Selection of the Designated Monitoring Area	First field season and after periodic evaluations	Action agency	Permittees and consulting agencies
IVa. Monitor TRIGGER INDICATORS	Field season annually	Permittee	Action agency
IVb. Monitor ENDPOINT INDICATORS	Field season annually at end of growing season	Action agency	Permittee and consulting agencies
Va. Evaluate ENDPOINT INDICATORS	Annually after ENDPOINT INDICATOR monitoring and before next bank-full event	Action agency	Permittee and consulting agencies
Vb. Determine and implement management changes	Annually after ENDPOINT INDICATOR monitoring and before next bank-full event	Action agency and permittee	Consulting agencies
IVc. Monitoring Long-Term indicators—RIPARIAN OBJECTIVES	Once every 3 to 5 years	Action agency	Permittee and consulting agency
Vc. Evaluate Long-Term indicators—RIPARIAN OBJECTIVES	After RIPARIAN OBJECTIVES monitoring	Action agency	Permittee and consulting agencies
Vd. Determine and implement management changes resulting from RIPARIAN OBJECTIVES assessment.	After RIPARIAN OBJECTIVES monitoring	Action agency	Permittee and consulting agencies

permit, the manager consults with the ID Team (and Level 1 Team where ESA consultation measures were not met) and determines whether a letter of noncompliance or permit action is warranted (Table 1).

Monitoring Guide

A monitoring guide has been prepared to assist field managers with selection of appropriate "trigger" and "endpoint" indicators for monitoring. The guide can be used to prescribe

Sample from the Monitoring Guide

- TRIGGER monitoring: Within-season trigger to move livestock, to maintain or increase vigor on key hydric stabilizers, use the following:
  - Stubble height on key riparian species, or key species groups on the greenline
  - Use compliance (livestock numbers and time in pasture)
  - Bank disturbance or alteration
- ENDPOINT Monitoring: End-of-season indicator of proper use to maintain or ensure increased composition of key hydric stabilizers:
  - Stubble height on key riparian species, or species groups on the greenline
  - Bank disturbance or alteration
- RIPARIAN OBJECTIVE monitoring: Long-term indicator of riparian condition to assess attainment of the Riparian Management Objectives:
  - Streambank stability
  - Greenline composition maintained or trend toward hydric stabilizers

streamside monitoring methods appropriate for various channel types[3] and existing and potential vegetative conditions along the margins of the stream channel at the green line. As an example, for "C" (low gradient) channel types with herbaceous vegetation dominant and potential vegetation herbaceous or mixed herbaceous and shrubs, the guidelines are given in Sidebar 4.

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Should I Fence the Streams, Ponds, and Wetlands in My Pastures?

Fencing pasture streams, ponds, and wetlands can improve fish and wildlife habitat and benefit agricultural landowners.

By William M. Giuliano

The Past

Historically, throughout much of North America, many streams, ponds, and wetlands were in or surrounded by forest or at least trees and other taller vegetation. These areas had a profound affect on the condition of these lands as well as on the fish and wildlife that inhabited them. Trees and other vegetation provided shade, keeping the water cooler in summer, and their root systems kept the banks in place. This provided food and cover for fish and wildlife, while keeping egg- and gill-suffocating silt out of the water.

Livestock Grazing vs Fish and Wildlife

Many fish and wildlife species that require these aquatic habitats and adjacent areas—called riparian zones—have been declining throughout much of North America over the last several decades. These declines appear to be linked to habitat loss and destruction associated with logging, intensified agriculture, and development. In these riparian areas, habitat losses due to agriculture appear to be particularly important, with as much as 250,000 acres lost annually in the United States. Uncontrolled grazing in and around streams, ponds, and wetlands appears to be especially important, leading to excessive disturbance, loss of food and cover, fecal contamination of water supplies, and streambank erosion (Fig. 1).

Figure 1. Grazing livestock in and around pasture streams, ponds, and wetlands reduces the value of these natural resources to fish and wildlife, livestock, and landowners.

Fencing Programs and Their Benefits to Landowners

Many popular game species and as many as half of the wildlife species considered "at-risk" are associated with streams, ponds, and wetlands. To address the problem of habitat loss and degradation in these areas, many federal, state, and private organizations have been working with agricultural landowners to implement fencing and restoration programs to protect and enhance these sites. Programs consist of fencing these important areas to exclude grazing livestock, and in some cases, replanting native vegetation and restoring topography and natural water flow (Fig. 2). Livestock access water at small, fenced stream crossings and access ramps, and troughs to which water has been diverted (Fig. 3). It was hoped, and has been confirmed, that such programs reduce disturbance to fish and wildlife; improve food, cover, and water quality and quantity; and reduce erosion. Additionally, the programs benefit farmers and ranchers through improved livestock health and production from enhanced water quality; fewer injuries associated with livestock use of degraded streams, ponds, and wetlands (including getting stuck in the mud or falling down an eroded stream bank); more water during summer and drought; the ability to rotationally graze pastures (because fences that protect riparian areas naturally divide pastures); and possible improvement of the performance of feeder calves by introducing them to man-made watering devices prior to arriving at feedlots and backgrounding pastures.

Fence construction and maintenance can be costly. However, program costs can be shared by landowners and cooperating agencies. The U.S. Department of Agriculture (USDA) Natural Resources Conservation Service and Farm Service Agency have been particularly important, providing reimbursement for much of the costs. Thus, landowners' expenses to implement this program on their properties are greatly reduced and appear to be far outweighed by the benefits obtained. Currently, landowners in many areas who enroll in the USDA's Wildlife Habitat Incentives Program, Wetlands Reserve Program, Conservation Reserve Program, Conservation Reserve Enhancement Program, and Environmental Quality Incentives Program can recoup much of the costs of program implementation, and may also be eligible to receive an annual rental payment to defray the cost of lost pasture acreage.

Fencing Programs Benefit Fish and Wildlife

Over the past several years, several researchers have been intensively examining the importance of these fenced areas to fish and wildlife. Fenced areas were found to support 88% more species than do unfenced areas, with many declining species preferring fenced habitats. Fish and wildlife found more often in fenced areas included cottontail rabbits, opossums, meadow voles, meadow jumping mice, white-footed mice, short-tailed shrews, masked shrews, hairy-tailed moles, ring-necked pheasants, great blue herons, green-backed herons, belted kingfishers, solitary sandpipers, song sparrows, yellow warblers, American goldfinches, eastern phoebes, willow flycatchers, grey catbirds, mallards, northern queen snakes, northern water snakes, eastern garter snakes, green frogs, northern dusky salamanders, creek chubs, emerald shiners, blacknosed dace, fantail darters, bluntnose minnows, and several types of invertebrates, to name a few. Fenced areas also appeared to improve wildlife reproductive success. Habitats that excluded grazing livestock had greater numbers of bird nests, fewer nests destroyed by livestock, and greater numbers of juvenile amphibians.

Wildlife preference for and success in fenced habitats appears to be because of the increased food and cover provided in these areas, reduced disturbance by livestock, and improved water quality and quantity. Fenced areas typically had thicker and taller cover than did grazed sites. This cover, while providing protection from predators and weather, also provides food for wildlife in the form of seeds, fruits, browse, and insects. Unfenced areas typically contained less food, allowed predators easy access to many species and their nests, and harbored increased numbers of livestock, which tram-

Figure 2. Fencing pasture streams, ponds, and wetlands to exclude livestock can benefit fish and wildlife, livestock, and landowners.

Figure 3. When pasture streams, ponds, and wetlands are fenced, livestock can obtain water from fenced stream crossings and access ramps (top photo), as well as from troughs to which water is diverted (bottom photo).

pled and disturbed fish and wildlife and their nests. Additionally, excluding livestock reduced fecal contamination of water, which enhanced conditions for many aquatic species that are often the “bread and butter” of the local food chain. The benefits obtained from fencing these habitats increased with the size of the area fenced. However, regardless of how small a fenced area was, it was better than a similarly sized unfenced site. Similarly, although not as beneficial as permanent exclusion, excluding livestock from these areas for part of the year was better than allowing continuous access.

So What!

Many landowners give their livestock free run of the land, often based on tradition rather than on a grazing management plan. This is unfortunate, as it can reduce the quality of the land for the owner, livestock, and fish and wildlife. To improve the quality of your land, improve conditions for livestock, and help many species of fish and wildlife on your property, the solution is simple: Fence Streams, Ponds, and Wetlands—It’s Win-Win Management!

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Cattle Raising in Central, Semiarid Rangelands of Argentina

By Hugo D. Giorgetti, Carlos A. Busso, Oscar A. Montenegro, Gustavo D. Rodríguez, and Nora M. Kugler

Introduction

Most rangelands are managed inappropriately in Argentina. This article provides some simple guidelines that can ensure a better grazing of rangeland vegetation and simultaneously increase beef production. Our main objective was to prove that a few simple management guidelines and a short-duration, high-intensity grazing system would increase beef production per acre, while at the same time maintaining the forage resource in the community.

Studies were conducted in the phytogeographical province of the Monte[1] (Fig. 1, 40°39′S, 62°54′W) in central Argentina. Average annual temperature is 54° to 57°F and rainfall is scanty with 8 to 12 inches annually concentrated in winter and spring; average annual evapotranspiration is about 31 inches per year. This is an extensive, almost continuous, and rather uniform area of shrublands. It constitutes the most arid rangeland of the country.[2] Monte vegetation is a steppe scrub dominated by microphyllous, xerophytic shrubs from 39 to 118 inches high[2] (Figs. 2 and 3). The most characteristic plant community dominating large areas of the Monte is composed of *Larrea divaricata*, *Larrea cuneifolia* and *Larrea nitida*; *Larrea* is the most abundant genus. The herbaceous understory is represented by *Pappophorum subbulbosum*, *Pappophorum mucronulatum*, *Bouteloua aristoides*, *Bouteloua barbata*, *Trichloris crinita*, *Eragrostis argentina*, *Stipa clarazii*, *Stipa tenuis*, *Poa ligularis*, and others.[3] The soil type is a typical haplocalcid, with an A horizon that is 20 cm

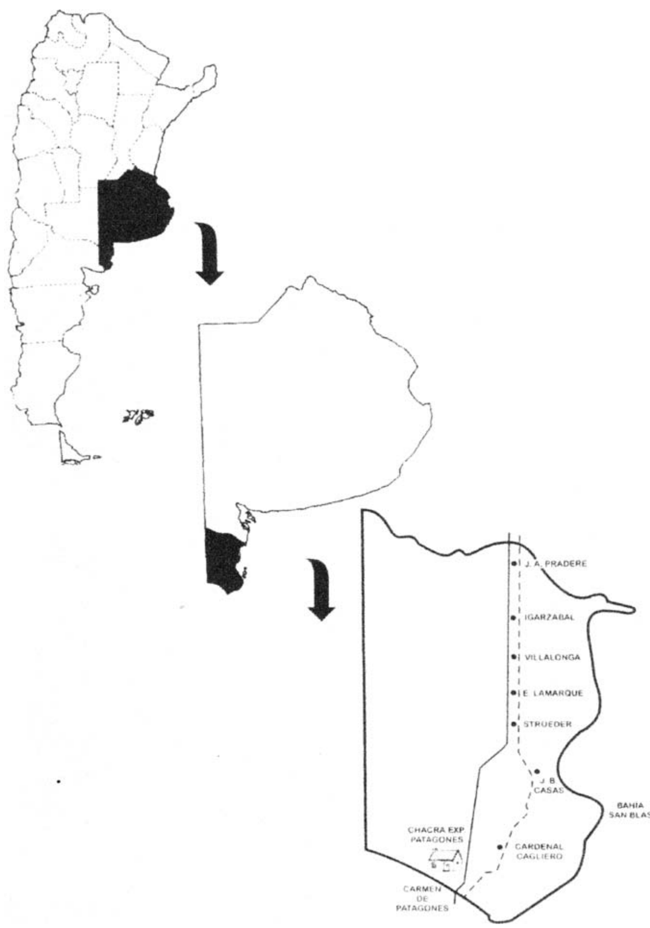

Figure 1. Location of the Chacra Experimental de Patagones in Buenos Aires, Argentina.

Table 1. Available and assigned forage, stay per paddock, and productive indexes during 1988–1998

Year	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	Mean
Precipitation (inches)	14.6	10.2	16.1	12.3	24.8	13.2	12.1	10.9	13.5	27.5	11.6	15.1
Total forage production (pound/acre)	1514.3	974.1	785.7	626.8	672.3	808.1	261.6	228.6	233.0	670.6	939.3	701.0
Assigned forage (pound/acre)	896.5	605.4	450.0	383.9	390.2	486.6	175.0	168.7	169.6	446.4	674.1	440.6
Observed stay/paddock (days)	86	52	46	34	52	52	28	19	23	50	72	47
Pregnancy (%)	94	97	100	86	96	96	89	89	70	92	86	90
Weaning (%)	84	90	100	83	93	90	84	84	70	86	89	87
Weight at weaning (pound)	394.6	410.1	451.9	434.3	454.1	432.1	372.6	363.8	330.7	346.1	319.7	391.8
Beef production (pound/acre)	17.0	18.7	23.2	18.7	22.3	19.6	16.1	16.1	13.4	15.2	14.3	17.7

deep.[4] This deep soil has a loamy sand texture, with 1.69% organic carbon, 28.7 parts per million available phosphorus, 0.123% total nitrogen, and an average pH of 7.

There are a few federal rangelands in Argentina. Most rangelands are private properties. The usual livestock producers, private owners, do not know much about how to manage their rangelands properly. Usual beef production on rangelands surrounding the study site is about 8 pounds per acre.[5] This is considering an average stocking rate of 29.6 acres per animal unit, a weaning percentage of about 60%, and an average weight of 375 pounds of a 7–8-month-old weaned calf. In Argentina, an animal unit is defined as the annual average dry forage requirement of an 882-pound cow that goes through gestation and subsequent nursing of a calf, until the 353-pound, 6-month-old calf is weaned, including the forage consumed by the calf. These values only represent estimates because the breeding season is year-round.[6] Beef production may be even lower if the calf–cow relationship obtained through agropecuarian census and vaccination programs from Services for Fighting Animal Health Problems is considered. Most rangelands are currently overgrazed, sanitary programs are nonexistent, and infrastructure is deficient.

Procedures

What follows is a description of changes in several management aspects, which ultimately proved to improve beef production in the experimental unit (Tables 1 and 2) when compared with the usual production system.

Experimental Unit for Beef Production

This unit was implemented in the Chacra Experimental de Patagones (Figs. 4 and 5) with the objective of obtaining an increased and sustained annual beef production per acre. Local information was then gathered,[7,8] as were basic management guidelines.[1,5,9]

Table 2. Comparison of productive variables between the Production Experimental Unit and the usual production system		
	Average usual production	**Production Experimental Unit**
Stocking rate (acres/animal unit)	29.6	19.3
Bull/cow relationship (%)	5	3.5
Breeding season	year-round	Nov.–Jan.
Pregnancy (%)	?	90
Cattle parturition (%)	-	92
Weaning %)	60*	87
Months to weaning	7–8	6
Weaning weight (pounds)	375	392
Beef production (pounds/acre/year)	7.6*	20.0

* Estimated data

Estimate of Forage Availability

Annual production of herbaceous vegetation was determined in areas of 49–98 acres. Vegetation included in permanent plots (n = 30; 20 × 20 inches) was clipped to 1.6 inches stubble height during 11 consecutive years every time cows entered each paddock. It was then separated by species, oven-dried to 158°F, and weighed. Species were grouped according to palatability: palatable, intermediate (low palatability), and unpalatable. More than 50% of the total plant biomass was composed by palatable perennial grasses such as *S. tenuis*, *Stipa longiglumis* and *Poa ligularis*, and 27% corresponded to intermediate perennial grasses (ie, *Piptochaetium napostaense*, *Stipa speciosa*, and *Aristida* spp.).

Determination of Stocking Rate

The following factors were considered to determine stocking rate: forage availability, forage sustained conservation, and cattle-raising requirements for each of its productive cycles. Forage availability was calculated to reach a good rangeland condition. With this purpose, the tendency and cover coefficient (TCC) was modified to determine biomass production. Such a coefficient considers 100% of palatable perennial grass cover, 50% of intermediate perennial grass cover, and 25% cover of annual species to determine rangeland condition.[9,10] A utilization coefficient of 70% was used. Stocking rate was adjusted to 19.3 acres per animal unit on the basis of an average annual forage production of 828 pounds dry matter per acre (during the period of 1984–1988), and an

Figure 2. Cattle within the shrubland with herbaceous stratum in the Chacra Experimental de Patagones.

Figure 3. Shrubland with herbaceous stratum in the Chacra Experimental de Patagones.

Figure 4. Entrance to the Chacra Experimental de Patagones. Its director, Agronomy Engineer Hugo D. Giorgetti, appears in the picture.

estimate of forage availability of 421 pounds dry matter per acre. Cow–calf requirements were calculated following Cocimano et al,[11] making adjustments to a monthly average value and considering the following characteristics: parturition during 3 months; weight increases in male and female calves of 1.5 pounds per day until weaning; weaning at the end of summer, and weight maintenance of nonpregnant female cattle.

Infrastructure, Diagram, and Management of the Unit

A surface area of 535 acres with Monte vegetation (Figs. 2 and 3), was divided with electric wire (Fig. 6) into 8 paddocks of 67 acres each. Initially, 29 Polled Hereford cows were incorporated and after 3 years, 14 of them were replaced by Aberdeen Angus cows. The breeding season was during November, December, and January (midspring to early summer) and cattle were checked for pregnancy by rectal palpation in April (early fall). Bulls composed 3.5% of the herd; they were removed from the system at the end of the breeding season. Calves were weaned at the end of summer and early in the fall. The percentages of pregnancy, parturition, and weaning, and weights of male and female calves at weaning were determined. Before the animals entered the paddocks, vegetation contained in 10 samples of 387.5 square inches each was clipped to 1.6 inches to estimate forage availability. In agreement with the utilization coefficient, animals grazed the 8 paddocks in a rotative way, with a variable frequency according with the forage grown each year.

Caution should be taken in extrapolating region-wide the new guidelines proposed for improving cattle raising in rangelands of central, semiarid Argentina. This is because the study was replicated in time but not in space. However, and as reported by Hulbert,[12] when the cost of replication is too high, pseudoreplicated studies can be the only or best option.

Findings

Stocking rates and paddock surface areas do not change in this production system. What changes is the cattle stay in the paddocks (Table 1). Any variation in stocking rate was the result of variation in the surface area grazed during the rotation system: some paddocks might be grazed more than once depending on year's characteristics (ie, either more or less annual precipitation). The average instantaneous stocking rate used was high (0.38 animal unit per acre), which reduced plant selectivity by animals to a minimum. This increased the utilization efficiency of plants, which can be observed if plant availability is related to stocking rate and stay in the paddocks. For a theoretical daily consumption of 20.5 pounds per animal unit,[11] 27.1 pounds of forage were anticipated (TCC). This would give a utilization efficiency of 75%. In practice, the observed consumption was 22.9 pounds per animal unit. This indicates that utilization efficiency of available forage increased to 85%. Observation of the main productive variables (Table 1) shows the stability of beef production achieved throughout years. This was achieved in an environment of highly variable seasonal and annual precipitation regimes, and it shows the advantages of the proposed production system.

Improvements in the productive variables in the Production Experimental Unit allow increases of beef production per acre greater than 160%, in comparison to values found in any usual production system (Table 2). Pound increases in beef production during 4 years are enough to pay off the investments required to carry out the Production Experimental Unit. Improving the production system with the guidelines reported in this manuscript will certainly increase household incomes.

Conclusions

Management practices such as establishing a breeding season, detecting pregnancy, and practicing rotative grazing are simple and known. The practice of increasing the num-

Figure 5. Facilities in the Chacra Experimental de Patagones.

Figure 6. Paddocks divided with electric wire in the Chacra Experimental de Patagones. Notice the electric wire to the left and behind the iron bar close to the wooden post.

ber of paddocks in the same surface area through use of electric wire is not difficult and it reduces costs. Fencing paddocks using electric wire is a simple task that is within the ability of the average livestock owner. Even ranchers with little theoretical knowledge of range management can use high instantaneous stocking rates, which shorten the stay of grazing animals in each paddock so that regrowth consumption of preferred forage can be largely avoided. It is then possible to develop a production system in the region similar to that employed in the Production Experimental Unit. This would allow sustainable increases of beef production per acre and year in the semiarid rangelands of central Argentina.

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Grassland Degradation and Our Strategies: A Case from Shanxi Province, China

By Zhang Jin-Tun

Introduction

Grasslands cover 41% of the earth's land surface and provide livelihoods for nearly 800 million people. Additionally, grasslands provide forage for livestock, wildlife habitat, carbon and water storage, renewable energy, recreation, and tourism. Grasslands also remain the primary source of genetic material for improving our food crops and for an increasing number of pharmaceuticals.[1,2] The health of the world's grasslands is declining largely due to human-induced modifications, such as agriculture, overgrazing, excessive use of fire, fragmentation of areas, and urbanization.[3] A recent study by the World Resources Institute to gauge the impact of human activity on grasslands found that a major reduction in the extent of grasslands has occurred in many areas.[4] For example, only 9.4% of North America is now covered by grasslands, and only 20% of Latin America.[4] Because of their contribution to human welfare, management of grasslands has become a more important part of environmental management worldwide.[5,6] Most research has focused on productivity, biodiversity, and the effects of grazing. Our understanding of grassland degradation includes its causes, mechanisms, restoration, and management but is not sufficient, particularly for grasslands in China.[7–10]

In China, grasslands cover more than 40% of the total land area, with 84% of that being located in western China.[11–13] Grassland is the largest terrestrial ecosystem of China, much of it semiarid and high plateau pastoral land. Grassland is the base of national animal husbandry, and is closely related to the food production of China. However, China's grasslands are being subjected to many negative forces and rapid change. According to Miller, estimates suggest that about 34% of all rangelands in China are moderately to severely degraded and about 90% are degraded to some degree.[14] Therefore, the management of grassland in China is extremely significant. This paper analyzes the present state of grassland degradation and its management strategies for the future, using Shanxi Province as an example.

Definition of Grassland Degradation

Grassland degradation can be defined as a kind of desertification. The desertification can be defined as land degradation in arid, semiarid, or dry areas because of climate change and human activities. The results of desertification are the reduction of biological and economic productivity or the decrease of biodiversity for cropland, grassland, and woodland, including the loss of soil substance, change of soil structure, and disappearance of natural vegetation.[15] In fact, grassland degradation is a retrogressive succession of grassland vegetation.[2,13]

Problems of Grassland Management

Grassland degradation has gradually increased in severity since the 1970s in China. The area of natural grassland is gradually shrinking and the quality is degrading. The capacity of grassland to feed animals is decreasing and most of the grasslands are being overgrazed. The productivity and biodiversity of grasslands are gradually decreasing, as is environment quality, which seriously threatens the sustainable development of China. Currently, 90% of the grassland is being degraded to varying extents,[2,13,16] among which the area of the grassland with serious degradation accounts for more than half of the total. The area of seriously degraded grassland has reached 185 million ha, and is increasing at an annual rate of 2 million ha.[7,17]

Table 1. Ecological types of grasslands and their characteristics in Shanxi Plateau

No.	Grassland types	Areas (10^4 ha)	% of the total grasslands	Distribution and characteristics	Elevation (m)	Productivity (t/ha)	Keeping livestock (sheep/ha)	Main species
1	Temperate steppe grassland	44.0	11.69	low mountain and hills in north and northeast Shanxi; chestnut and loess soil	< 1,500	3.10	270	*Stipa bungeana, Thymus serpyllum, Cleistogenes chinensis, Cleistogenes squarrosa, Astragalus scaberrimus, Polxgala tenuifolia, Artemisia vestita, Lespedeza davurica, Agropyron cristatum, Gueldenstaedtia multifiora*
2	Temperate scrub–grassland	140.1	37.22	low hills in south Taihang, Luliang Mountains, Qinxian, Qinyuan, Zuoquan Mountains; cinnamon soil with bare rocks	800–1,700	4.21	150	*Bothriochloa ischaemum, Themeda triandra var. japonica, Vitex negundo var. heterophylla, Hippophae rhamnoides, Poa annua, Zizyphus jujuba var. spinosa, Heteropappus altaicus, Roegneria kamojiohwi*
3	Temperate grassland	60.51	16.08	wide area south of Hengshan Mountains; cinnamon and mountain cinnamon soils	1,300–2,000	5.0	190	*Bothriochloa ischaemum, Arundinekka hirta, Artemisia spp., Pao spp., Carex lanceolata, Themeda triandra var. japonica, Heteropappus altaicus, Elymus dahuricus, Festuca sp.*
4	Temperate bush land	80.00	21.26	Luya Mountains, Guandi Mountains, Guanqin Mountains; mountain cinnamon and meadow soils	1,400–2,000	4.70	180	*Hippophae rhamnoides, Rosa xanthina, Lepedeza bicolor, Ostryopsis davidiana, Rosa xanthina, Spiraea pubescens, Artemisia spp., Carex spp., Potentilla chineensis, Medicago falcata*
5	Mountain meadow	37.00	9.83	cold area above forest line in Taiyue, Taihang, Luliang, Wutai, Hengshan and Zhongtiao mountains; meadow soil	> 2,000	6.90	75	*Carex spp., Cobresya bellardii, Avena fatua, Oxytropis coerul, Festuca ovina, Sanguisorba officinalis, Polygonum viviparum, Cleistogenes spuarrosa*
6	Temperate "Savannah" grassland	11.44	3.03	forest edge and tree windows area in all mountains; mountain cinnamon soil	1,700–2,400	4.37	120	*Deyeuxia arundinacea, Spodiopogon sibiricus, Vicia unijuga, Bromus inermis, Setaria viridis, Medicago falcate, Vicia amoena*
7	Wet meadow	3.34	0.89	wet land along rivers, around water reserve and lakes; wet meadow soil	240–800	3.90	105	*Calamagrostis pseudophragmites, Phragmites communis, Tamarix chinensis, Pennisetum alopecuroides, Salsola collina, Carex spp. Ranunculus tanguticus*

Photo 1. Moderately degraded mountain meadow grassland in Luya Mountains, Shanxi.

Grassland degradation is the main challenge facing grassland managers in the new century for China. To establish sustainable grassland farming in China, we have to study the cause, classification, restoration, and control strategies of grassland degradation. Here we use Shanxi Province as a case to study these problems.

Shanxi Province, a part of loess plateau, is located at N34°35′–N40°43′, E110°15′–E114°33′, and is a mountainous province in China rich in natural grassland resources. There are 3.76 million ha of natural grasslands. However, large areas of grasslands were degraded in the past few decades because of overutilization and worsening natural conditions. Over 80% of the total land area is mountainous, and most lands are over 1,000 m. The highest mountain in Shanxi is Beitai, the main peak of the Wutai Mountains with an elevation of 3,058 m, and the lowest land, with an elevation of 245 m, lies in Yuanqui County in the south of Shanxi. The area has a continental climate, being warm and rainy in summer, cold and dry in winter. The annual mean temperature varies from 8°C in the north to 12°C in the south; the mean precipitation varies from 350 mm to 570 mm. Based on the system of national vegetation regionalization, 2 vegetation regions are recognized in this province:[17] a temperate steppe region distributed in the north, and a warm temperate deciduous broad-leaved forest region in the south. The boundary of these 2 vegetation regions is the Hengshan Mountain range. Correspondingly, 2 soil regions, the chestnut soil region and cinnamon soil region, can be identified.[18]

The Causes of Grassland Degradation

There are various factors causing grassland degradation, such as long-term drought, wind and water erosion, dust storms, plagues of rats and insects, and other natural factors as well as excessive grazing, heavy mowing, transferring grassland to farmland, digging medicinal plants, mining, and other human economic activities.[8,19–20] The interactions of these factors can speed up grassland degeneration; for instance, wind erosion of soil can lead to loss of soil water and to desertification, which could cause plagues of rats and insects.[2,8] In the literature, different authors emphasize different factors.[21,22] The grasslands have been used for a long time by human beings in northern China, but their serious degradation started only 40 years ago when population increased quickly, which implies that human activities are the main factors affecting grassland degradation.[8,23]

Almost all grasslands in Shanxi plateau are in a degrading condition.[2] Human activities are the principal factors affecting this procedure. Many grasslands in mountainous areas below 1,200 m have been reclaimed into cropland. It is difficult to find a continuous grassland in this region due to such reclaiming. The water and soil loss becomes serious and soil quality becomes low after reclaiming. The local farmers do not invest in the land by using grassland–cropland rotation farming systems; rather, they continuously grow crops, which destroys the land.[2]

Digging medicinal plants, collecting fire-grass, and felling firewood in a grassland can cause its degradation. There are many medicinal plants in Shanxi, including licorice, Huangqi, mahuang, and huangqin. Shanxi was famous for its production of licorice in 1950s–1970s, but now it is not worth it to collect this medicinal plant in this province because of extensive digging and degradation of grasslands. The diggers of licorice have moved to other provinces to continue their digging.[24,25]

In upland grasslands above 1,200 m, overgrazing is common and its influence on grassland degradation is obvious. Grassland farming in Shanxi mainly uses natural grasslands. The farmers wantonly increase the number of livestock regardless of the carrying capacity of grasslands. Excessive grazing may result in 3–5-fold decreases in grassland productivity. Soil structure is destroyed because of heavy trampling by animals, which will cause plagues of rats and insects.[22] Some grasslands cannot be used for grazing any more. In addition, the development of industry and urbanization are also factors affecting grassland distribution area and degradation.[8]

The excessive cutting of plants is another cause leading to grassland degradation. Because of limitation of transportation and difficulty in obtaining fossil fuels in some mountainous areas, the local residents mainly use biological energy.

Photo 2. Seriously degraded temperate grassland in Western Shanxi.

Mowing natural grasslands to provide winter feed for livestock is very common in mountainous areas because of the relatively long period of snow cover and the very limited area of artificial grasslands in Shanxi. These actions are detrimental to grasslands and may cause further grassland degradation.

Aside from human activities, some natural factors cannot be ignored in their role in grassland degradation in Shanxi. Frequent droughts, global warming, strong winds, uneven precipitation, and other factors all affect grassland degradation.[26] According to the climate records of the past 40 years, the change of annual precipitation in Shanxi is great, with a ratio of 46%–95% change between years. The precipitation in a rich year is 2.6–3.5 times of that in a poor year. In the years of drought, wind and dust storms, hailstones, plagues of rats and insects become frequent, which may quicken grassland degradation.[27]

Photo 3. Extremely degraded temperate scrub–grassland in Northwest Shanxi.

Grassland Degradation in Shanxi

Grasslands are principally distributed in mountains and hills in Shanxi Province. The classification of grasslands in Shanxi has been carried out many times by using different standards.[15,23] The vegetation classification standards are the most common regulations used in grassland classification,[17] ie, the constructive species, dominant species, and compositions of plant communities are the major principles for grassland classification in Shanxi. Based on remote-sensing image data of 2000 and a field survey in 2001, 7 types of grassland can be identified according to the criteria above (Table 1).

Shanxi is one of the provinces most seriously affected by grassland degradation in north China.[21] Over 95% of grasslands in this province have been degraded to some extent.[2] By using the degradation classification system summarized in Table 2, the area and percentage of degraded grasslands for each type of grassland in Shanxi are listed in Table 3. Some examples of degraded grasslands in Shanxi province are shown in Photos 1–3.

Strategies of Controlling Grassland Degradation

From the analysis above, we can see that Shanxi's grasslands are under unsustainable utilization. Degradation of grassland is continuing and worsening. Additionally, the demand for livestock industry development is imminent because of the increasing population and desired improvement of quality of life. Local government has to pay more attention to grassland-based economics, with a focus on protecting natural grassland and recovering degraded grassland, to meet the requirement of sustainable development. We put forward the following suggestions:

1) Establish a capital value system for grassland. Because the possession of grasslands belongs to the government and the access rights to grassland are not clearly established, grassland has no perceived value in China. This is one cause of grassland degradation. We should treat grassland as an important asset, and get reimbursement and investment from its utilization and for its use, restoration, and protection. It is urgent to establish a capital value system for grasslands, and to implement a series of policies to determine the accessibility of grasslands.
2) Harness and restore degraded grasslands and reconstruct pastoral grasslands. The number of livestock has exceeded the carrying capacity of grasslands in Shanxi because of large-scale degradation. If the husbandry industry needs further development, grassland area and yield will first have to increase. There are 2 ways to solve this problem. One is to harness and recover the degraded grasslands and improve their ecological situation by increasing yields. The other is to develop pastoral grasslands. There are many successful examples in practice; in one case, great ecological and economic benefits have been obtained from restoring natural grasslands and developing planted grasslands as part of the management of small watersheds of the Wangjiagou Valley in western Shanxi.[27]
3) Manage grasslands legally. The management of grasslands has to comply with *The Law of Grasslands, The Law of Environmental Protection,* and *The Law of Natural Conservation* to protect grasslands from such unsustainable utilizations as reclaiming, denudation, overharvesting, and excessive grazing, and enforce punishment for illegal activities. In mountainous regions with large contiguous grasslands, national parks or natural reserves should be developed to meet the needs of biodiversity conservation, ecological traveling, and scientific research.
4) Control population in mountain regions. Overpopulation is one key reason for grassland degradation; populations are too large, with high rates of increase in mountainous and poor regions in Shanxi. The pressures of population on grasslands and other natural environments are so great that ecological damage is serious. Controlling population is urgent if the natural environment is to be conserved in these regions.
5) Strengthen grasslands research and training programs. There are many theoretical and practical problems that

Table 2. The classes of grassland degradation and their characteristics based on the usability for livestock and availability of the grassland environment

Degradation class	Species composition	Biomass and cover above ground	Surface coverage and situation	Soil status	Ecosystem structure	Resilience
I. Weak degradation	no change of original species composition, individual number of dominant species and palatable species decreased	< 10% decreased	good surface coverage	no change	no change	self-recovered in natural conditions
II. Light degradation	no great change of original species composition, individual number of dominant species decreased, palatable species decreased or disappeared	20%–35% decreased	surface coverage decreased	no obvious change, soil rigidity increased	no obvious change	quickly recovered in natural conditions after closed
III. Moderate degradation	constructive and dominant species change greatly, most original species still remain	35%–60% decreased	surface coverage disappeared	1-fold increase of soil rigidity; soil erosion obvious; salinity increased in wet areas	carnivores decreased; herbivores including rodents increased	May recover in natural conditions after closed
IV. Serious degradation	most original species disappeared, composition simplified, short and trampling-tolerant species dominated	60%–85% decreased	soil surface bared	2-fold increase of soil rigidity; soil organic matter decreased obviously; soil sand increased; salty patches obvious	food chain shortened; ecosystem structure simplified	Hard recovery in natural conditions, need improving measures
V. Extreme degradation	vegetation disappeared, only some weed species	> 85% decreased	bared land or salty patch	no value to its use	ecosystem disorganized	Need reconstruction

need to be solved to control grassland degradation. Research programs studying mechanisms of degradation, identifying main factors affecting degradation, and controlling degradation should be established.[7] Scientific management of grasslands based on these research programs may result. It is necessary to have many technicians, managers, and teachers working to control grassland degradation and management. We should start training programs to train technical persons and educate farmers, who will be important in future efforts to recover, harness, conserve, and manage grasslands.

Table 3. Statistics of degradation for each type of grassland in Shanxi Plateau

Types	Areas (10^4ha)	Degradation classes and areas (10^4ha)											
		No degraded		I		II		III		IV		V	
		Area	%	Area	%	Area	%	Area	%	Area	%	Area	%
1	44.0	0	0	0	0	5.1	11.6	8.6	19.6	17.2	39.1	13.1	29.8
2	140.1	2.8	2.0	4.4	4.0	41.5	29.7	56.7	40.5	29.3	21.0	5.4	3.9
3	60.51	0	0	3.6	6.0	8.1	13.4	28.7	47.5	18.9	31.3	1.21	2.0
4	80.0	2.1	2.7	6.3	7.9	26.5	33.2	27.4	34.3	16.5	20.7	1.2	1.5
5	37.0	6.0	16.3	8.6	23.3	15.8	42.7	6.1	16.5	0.5	1.4	0	0
6	11.44	1.7	14.9	3.9	34.1	4.1	35.9	1.1	9.7	0.64	5.6	0	0
7	3.34	0.6	18.0	0.8	24.6	0.9	27.0	0.54	16.2	0.3	9.0	0.2	6.0

Note: Grassland types same as in Table 1.

6) Constitute favorable policies for grassland industries and intensive management. The current government investment in the grassland and husbandry industries is small, and farmers themselves have little capital. Therefore, the mismanagement and overutilization of grasslands are only continuing. Shanxi should constitute favorable policies to attract capital investment to grassland farming and industry, which would be conducive to sustainable development of Shanxi's economy and environment.

Summary

The present utilization and management practices of grassland farming in China, as the above case of Shanxi Province illustrates, are unsustainable. They do not accommodate the requirements of future development.[8,13] The sustainable development of grassland farming refers to the enlarging of resource potential and the increased carrying capacity of grassland, which demands the improvement of grassland quality and primary production.[3,23] The restoration of degraded grassland is critical for realization of sustainable grassland farming in China. Like the management of any natural ecosystem, grassland management is also important to keep natural environments stable. Therefore, sustainable grassland farming is a part of a larger process of environmental sustainable development.[2,19,28]

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Gold Rush to Glory

A Tribute to the Stone Family—Winners of the Colorado Section Society for Range Management 2005 Excellence in Rangeland Conservation Award.

By Sheila Lamb

The gold-rush days of Cripple Creek, Colorado, have passed with the last century, leaving behind physical reminders of this era in the form of rock piles, stained ore holes, and miles of ditch. At a time when resources were exploited as a means of survival, the value of products was paramount to what was left in their wake. With the heyday of mining and ranching went tons of ore, soil, water, and vegetation. It is not what we would choose today, but fighting for a life in the Wild West demanded these uses. Our history is exactly that: history.


Entrance to the Stones' ranch.


The Stones' meadow.

Driving north out of Cripple Creek today, one's eyes are treated to a new sight, a new gold rush of sorts, exemplified in land held by descendants of homesteaders in the Florissant area. Nearing Evergreen Station, Dome Rock, and Mueller State Wildlife Area, vibrant green meadows, glassy creeks, and tangles of willows spring into view. This is the home of the Stones: Howard, Barbara, and their son Colby, who have made a new life from the life of the past.

In talking with Howard, he describes his father's struggles with the land, different climatic conditions (back when it

Riding.

actually rained and snowed), and trying to balance work with ranching and family. In the decomposed granitic soils of the area, gullies washed and streams eroded. The Stones have spent the past 3 decades rebirthing their ranch without blame. They have learned from many as they have raised their own private phoenix from the ashes of the past. Now it is their time to teach.

With gutsiness and hard work, they have built erosion-control dams, reseeded, timbered, irrigated, fenced, developed water, and gracefully used cattle to bring their ranch into a glory of its own. Teeming with a varied multitude of wildlife, birds, insects, and vegetation, the Stone ranch hardly looks like the "classic" ranch of the west. Visitors might even think they are within the boundaries of the neighboring State Wildlife Area, but instead, this is the new ranch of the new west.

The Stones run over 200 pair of Hereford-cross cattle on a Forest Service grazing allotment in conjunction with long-time neighbor and area resident, Ernie Snare. Their livestock are on public lands from about June to October. This is where we first saw that they did things differently than most. There was no whooping-up the cows, no sagging fence lines, no drippy or dilapidated water sources, no beat-out or scalped-off grazing areas. As a Range Management Specialist for the Forest Service, when I first asked to see the Stones' ranch, I knew I was in for a treat. I just didn't know how sweet it would be.

Part of the Stones' success is attributed to the way they have integrated their grazing management to include a patchwork of public lands, private leases, and their home ranch. Each grazing area receives an adequate measure of rest throughout the year, which is a critical factor in grazing the arid intermountain west. Varying their rotation ensures that different areas are grazed at different times of the year and that no one plant species is continuously benefited at the expense of another.

The Stones' award.

We all know what poor ranch and rangeland management looks like. With big-hearted neighbors like the Stones generously sharing their time and knowledge, perhaps we can all look forward to seeing more gems in the aftermath of a gold rush.

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Full-Text Online Access to Society for Range Management Journals

By Jeanne L. Pfander, Yan Han, Lindsay Wyatt, and Marianne Stowell Bracke

Introduction

In the past 10 years, full-text journal content on the World-Wide Web (WWW) has exploded. In 1996, the *Directory of Electronic Journals, Newsletters and Academic Discussion Lists,* published by the Association of Research Libraries, listed 1,689 journal and newsletter entries, 90% of which included a Web address.[1] By late 2003, approximately 14,600 online and active and academic/scholarly or refereed journals were available.[2] Customer demand, especially on university campuses, is high. Readers appreciate the convenience of being able to access full-text online copies of articles 24/7 from the comfort of their offices, labs, dorm rooms, or homes. The expectation that you can (or should be able to) find everything on the Web has become ubiquitous. Librarians have been eager to satisfy customer needs for more full-text online content. Even so, there have been issues of pricing and also quality control in online journals, especially regarding information-rich images and so on in scientific journals. In addition, librarians have had concerns regarding the licenses for online journals, especially pertaining to perpetual access to content paid for in the event a subscription is canceled.

Publishers have been feeling their way in this new arena, unsure of the economic model to follow. Contributing to the dynamic state of affairs has been the open access movement. Many librarians and other faculty or researchers in academia and government have argued for free access to journal articles, especially when the research has been funded by taxpayers. (For more information on the open access movement, see the Wikipedia article "Open access" at http://en.wikipedia.org/w/index.php?title=Open%20access&oldid=29738975.)

The University of Arizona Library, working with the Society for Range Management, was a pioneer in the mid-1990s in providing full-text Web-based open access to the early volumes of the *Journal of Range Management* (*JRM*). More recently, volumes 1–20 (1979–1998) of the journal *Rangelands* have been digitized by the University of Arizona Library. This paper describes the history of both digitization projects, their current status, and plans for the future.

AgNIC Rangelands and the University of Arizona

The University of Arizona (UA) has been a part of the Agriculture Network Information Center (AgNIC; http://www.agnic.org), centered at the National Agricultural Library, since its inception in 1995.[3] The UA chose to develop a Web-based information center for rangelands since they are crucial to Arizona but are also of global importance and therefore appropriate as a topic for AgNIC. The mission of the Arizona AgNIC project is to provide electronic access to the full scope of information in the field of rangelands and rangeland management to people everywhere and of all knowledge levels by collecting, creating, evaluating, and organizing relevant resources. The Arizona Rangelands site resides at http://ag.arizona.edu/agnic/az/index.html.

AgNIC Rangelands has continued to evolve. In 2002, the Arizona AgNIC team brought together cooperative extension agents and librarians from land grant institutions from 12 western U.S. states to expand the AgNIC Rangelands project.[4] This initiative, which has since grown to 21 participating institutions in 19 states, is now known as the Western Rangelands Partnership, and a central Web site has been created named Rangelands West (http://rangelandswest.org). From this site, links lead to state pages that address local needs and issues.

Digitizing *JRM*

The Arizona AgNIC Rangelands team has a long history of pursuing opportunities to create or support the creation of online access to more content. In 1995, 2 events were taking place that came together serendipitously. SRM contacted the National Agricultural Library (NAL) about the possibility of digitizing back files of *JRM.* At the same time, the Arizona AgNIC project was just getting off the ground and was beginning to add content to the site. NAL brought the 2 groups together. The UA entered into an agreement to digitize the back files of *JRM,* and a memorandum of understanding between the UA, SRM, and NAL was drafted. NAL provided funds for the digitization work. SRM agreed to provide the print copies of the back issues from 1948–1994 for the Arizona rangelands project team to scan. The process of scanning, plus creating the Web architecture for delivering the initial online back files, was done in house at the UA Library and was completed in 1999.[5] Two years later, the project team added volumes for 1995–1998 that were provided in digital form by Cornell University as a by-product of TEEAL (The Essential Electronic Agricultural Library; http://teeal.cornell.edu/). More recently, additional volumes for 1999–2001 have been provided by SRM in digital form. SRM will deliver additional volumes as the rolling window agreed on in the memorandum of understanding continues to move. The *JRM* archive site (http://jrm.library.arizona.edu/) includes the full text for all issues of the journal from 1948 to 2001. Issues can be accessed by browsing through an index by date. For the years 1983–2001, the archives can also be searched by general key word, author, or title.

Digitizing Rangelands

For several years, the Arizona Rangelands AgNIC group had been discussing the desirability of working with SRM to make the back files of the journal *Rangelands* available online. In April 2004, NAL announced that funding for small cooperative agreements was being made available to AgNIC partners. The objective of the cooperative agreement was to support an effort between participating institutions and NAL to build full-text content that would deliver information to Internet users through the AgNIC (M. Gardner, unpublished e-mail communication, 2004). The authors of this paper submitted a proposal to digitize volumes 1–20, 1979–1998, of *Rangelands.* The proposal was funded by NAL.

An agreement similar to that developed for the earlier *JRM* digitization project was reached between the UA and SRM for the digitization of *Rangelands.* SRM agreed to provide 1) print copies of volumes and 2) rights to unlimited, free-of-charge use of the digitized data consistent with Title 17 of the U.S. Code on Copyright. The UA Library agreed to 1) scan the printed material and create digitized TIFF and PDF files, 2) make this information available over their Web site, 3) provide SRM with 2 free copies of the TIFF and PDF files and make additional copies at cost if requested, and 4) make the *Rangelands* articles from the UA Library

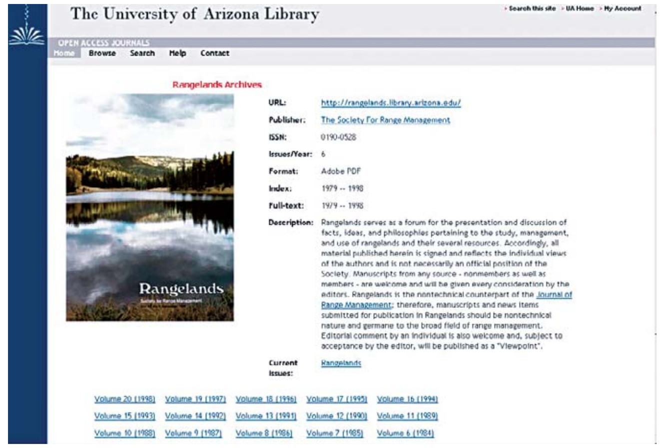

Figure 1. Rangelands Archives Web site.

Web site directly accessible from other Web sites that emphasize rangeland information, particularly the SRM home page site (http://www.rangelands.org/).

The UA Library outsourced the scanning work. A vendor was selected and a contract signed regarding the requirements, costs, and timing for completion of the work. When the contract was in place, SRM shipped the *Rangelands* volumes to the vendor for digitization.

The UA Library project team designed the *Rangelands Archives* Web site with the objective of providing an optimum customer experience. With a few clicks, customers can easily browse, quickly locate, and access full-text articles.

SRM and Online Access to Recent/Current Volumes

A related development has been the partnership between the SRM and Alliance Communications Group (ACG). Over the past few years, the *Rangelands* and *Journal of Range Management* Steering Committees have worked with the editors in chief, associate editors, and ACG staff to redesign the 2 SRM journals.[6] *JRM* has been renamed *Rangeland Ecology & Management* (*REM*). Current issues and recent volumes of both journals are now available full-text online.

SRM members have access to *Rangelands* (print and online) through their basic membership status. For an additional $30.00 (as of January 1, 2006), members can subscribe to *REM* (print and online).

Both SRM journals are also available to institutions on a subscription basis through BioOne (http://www.bioone.org), beginning with the volumes for 2004 and continuing to the present.

Next Steps for the Archives

SRM will continue to provide the full-text journal articles in electronic form to the UA Library for both the *Rangelands* and *JRM/REM* Archives sites. This will be, as before, on a rolling window basis, with content available via the UA open access archives 2–3 years after being published.

The UA Library has several enhancements in the works for the Archives. We are working to fill in gaps in indexing for articles in both *Rangelands* and *JRM*. Indexing records allow users to search the Archives by author or keyword. With permission from the National Agriculture Library, the UA Library project team had downloaded AGRICOLA database records for both SRM journal articles. It was determined, however, that 100 articles in some of the issues of early volumes (1979, 1980, and 1981) of *Rangelands* do not have records. The project team is currently indexing these articles and expects to complete and load those records before March 2006. In addition, pre-1983 *JRM* articles were not indexed by AGRICOLA, and the UA Library will be adding indexing to allow key word and author searching for those volumes as well.

Sustainability and maintenance of the Archives is an ongoing concern. The UA Library will continue to evaluate the appropriateness of changing technologies and work to create a consistent and user-friendly Web interface and digital infrastructure to host the *JRM/REM* and *Rangelands* Archives.

Conclusion

The UA Library and SRM have a productive working relationship. By making the valuable intellectual content of the SRM journal publications available online, the creativity and productivity of researchers, students, resource managers, and decision makers concerned with rangelands will be enhanced.

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Thad Box

On Choosing the Right Whetstone

When I wrote in the June *Rangelands* that our profession is not a job but the dedication of a life to an ideal, some readers hinted I had abandoned science and gone to preaching. Maybe so, but how we treat land is largely determined by our understanding of the interconnectedness of our job to the land. That understanding is based on science. But what we do with our science is an ethical decision based on morals.

My grandfathers didn't agree on details of morality. Granddaddy Box was super religious. His God drove him to admonish people for drinking whisky, swearing in front of women, and having fun on Sunday. Granddaddy Hasty never went to church. He kept a bottle of bourbon for snakebites. His God urged him to help his neighbor. He neglected his own crop to plow corn of the man whose legs were crushed when a horse fell on him.

They agreed on one thing: it was morally repugnant for a man to have dull tools. Each carried a pocket knife and a whetstone. After use, a knife was drawn across the whetstone, then the edge was polished by several swipes on a leather boot. The knife went back in the pocket as sharp as a surgeon's scalpel, ready to peal a peach, remove a thorn from a child, trim proud flesh from a horse wound, cut a chew of tobacco, or castrate a calf.

Those values followed Dad when he became a construction boss. He fired carpenters who wouldn't set their saws and sharpen them before work. And he wouldn't tolerate a man who used an ax to shape a rafter. The choice of the right tool was as important to him as keeping the tools clean and sharp.

Like most moral rules, the insistence on sharp tools and using the right tool to do a job have practical bases. Survival often depends on it. Even when survival is not in question, work is more efficient when sharp tools are applied to an appropriate task. Since sharpening tools is usually done in "spare" time, dull tools indicate lack of dedication. And choice of tool depends on knowledge and experience. It's easy to go from those things to judging a man's character by the sharpness of his blade.

The wisdom behind sharp tools guided me from youth to old age. As a young man, I was drafted into the Army. Although I complained about having to clean and oil my rifle each night, even when it hadn't been fired, it made sense. Although I hoped I would never have to fire at a human being, I wanted my rifle to work if needed.

In college, I found that knowledge is a most powerful tool. And it was easy to tell which teachers kept their tools sharp. Those who taught from a textbook had dull classes. The teacher who did research or read a lot and brought new studies to our attention operated with sharp tools. And these were the same teachers who took us on field trips to evaluate the interconnectedness of nature, to experiment stations to examine new tools, and to progressive ranches to see the results of applying knowledge.

Throughout life, I have found myself checking the sharpness of tools. I find that colleagues who read and solve problems are the ones I depend on. Ranchers who attend workshops and apply current research are prized stewards of the land. When I interview a medical doctor, I ask about his training—not just the schools he went to but also what training courses he takes each year, what journals he reads, and who he consults.

I find public servants who openly mingle with and learn from those who disagree with them to be our best. When a politician asks for my vote, I ask what data source he depends on for decisions, what expert opinion he seeks, what books he has read recently, and which newspaper columnists he admires.

You get some interesting answers when you question the dullness of a person's tools. You find equally interesting situations when someone uses the wrong tool or has only one tool in his kit. There is an old saying that to a man with a hammer, every problem becomes a nail. Neither my grandfathers nor my father went past the fourth grade. But they were smart enough to know that you can't trust a man who doesn't know how and when to use his tools.

This issue of *Rangelands* is devoted to grazing management. Grazing management is not an end in itself. It is a bag of tools. We use them in our quest for sustainability. We can also use them to harm the land by seeking quick profits.

We do not look favorably on an SRM member who manages grazing for short-term gain and diminishes the productivity of the land. Such action violates the land ethic that guides us. It goes against the objectives for which our Society was formed—the objectives that are printed in the front of each of our journals. The value of our land care profession is determined not by the tool but by how we use it.

We have more tools in our bag, and they are more specialized, than those taught in my first range management courses. Dr. Vernon Young stressed four major elements in proper grazing: kind of animals grazed, numbers (intensity of grazing), season of use, and distribution of grazing. These are as important today as they were 90 years ago, when Jardine, Sampson, and other grazing pioneers started developing such tools for our profession.

Our tools today are much superior to those we had in 1975, when Art Smith and I revised the last edition of *Range Management.* The principles of range management outlined by the classic textbooks of Sampson and Stoddart and Smith are still valid. But research has shown that some of the tools used to get to those principles were mighty dull. And in some cases, the tools were just plain faulty.

New tools have been developed and old tools sharpened in three important areas of grazing management: ecological succession, carbohydrate storage and nutrient cycling, and animal behavior. These improved tools do not invalidate the four major principles of grazing management described in separate publications by Sampson and Jardine in 1919. They just give us a much better way to succeed.

While we were developing tools for grazing management, the invention of X-ray gave medical doctors their first crude tool to look inside the human body. They could distinguish between air, fat, muscle, and bone. Today, modern hospitals have CT scans, ultrasound, and MRI devices interacting with computer tools that allow a physician to look inside every organ of the body. It is now possible for a surgeon to use images and computer technology to know intimately what he will find when he makes his first cut. He can actually do virtual dry runs of an operation before he enters the operating theater.

Some say that in 10 years our annual physicals will consist of reporting for a whole-body scan and walking to our physician's office, where the doctor will go over the details, including probabilities associated with each problem on a computer screen.

But with all the great tools available to the medical profession, our health depends on the morals and ethics of people, individually and collectively. It depends on whether our doctor has the latest tools available and is properly trained in their use. It also depends on whether our people as a whole, through economics and politics, make the tools and doctors available to everyone or only a few who have money to pay for them. Human health is a product of societal values. So is land health.

As land care stewards, we are guided by our professional values: do good science, apply that science ethically, and take responsibility for our actions. Being a technician can be just a job with tasks to be done and a paycheck to be collected. But most people in our Society are not range managers because of money; they have dedicated their lives to making land better.

We may disagree on what "better" means. Some think better is producing more livestock products. Others see it as increasing water yield or more beautiful landscapes or greater species diversity. But increasing the output of any good or service in the short run does not necessarily fit the societal goal of keeping options open for future users.

If sustainability is our goal, we look beyond the current generation. We use an ethical whetstone to sharpen our tools. We work to ensure that long-term productivity of the land will not be impaired by any short-term use. I still think implementing that goal is not a job—it is the dedication of a life to an ideal.

Thad Box, thadbox@comcast.net.

Eleventh in a Series: Insight From SRM's Charter Members

The SRM History Committee has conducted interviews with many of the Society's Charter Members to capture their perspective of events leading to and subsequent to the formation of the American Society of Range Management in 1947–1948. Interviews from several of these individuals will be shared for today's SRM members to enjoy and learn from.

SRM Charter Member – John Morris Fenley

Editor's Note: John Morris Fenley, 1745 Eldena Way #116, Modesto, CA 95350-3570, a retirement center, has had a most interesting career, and this synopsis can only briefly relate it. A complete transcript can be made available on request.

John Fenley received a BS in 1939 from the University of California, Berkeley, in Forestry and Range Management. He started university at UCLA in civil engineering, but after a summer's work in northern New Mexico on a sheep grazing problem (poisoning by pingue), he changed majors, and after completing the basic course work at UCLA transferred to Berkeley. He also holds an MS in range management and forestry from UCB in 1948 and a PhD in extension education from Cornell University in 1958.

John started work on his MS at the University of California, Berkeley, but could not complete it until after the war; he served in the Army from 1942 to 1946. He transferred from the Soil Conservation Service at Lakeport, California, in 1946 to the Intermountain Forest and Range Experiment Station stationed at the Great Basin Research Center in Ephraim, Utah, under Perry Plummer. At the Great Basin station, he was a range ecologist, ultimately to be stationed in Nevada, as he was in Ephraim for training in range reseeding techniques. In the late fall of 1947, with several other technicians in Ephraim, he attended Regional meetings in Ogden, Utah, to organize what turned out to be the range management society. Joe Pechanec of the Pacific Northwest Forest Service Region chaired that meeting. Interest was immediate and overwhelmingly sufficient for the American Society of Range Management (ASRM) to be formed. The Society was to become a living entity.

John's research location was in Paradise Valley, Humboldt County, Nevada, and he was transferred there in late 1947. During winter, he was living in Ogden and was able to attend the first meeting of the ASRM in January 1948. John was able to obtain a leave of absence and complete his MS at Berkeley under the GI Bill of Rights in June 1948. He and his wife, Eileen, returned to begin his range reseeding research activities in Nevada. John and Eileen's 3 children, Janice, Rick, and Molissa, were born in Nevada in 1948, 1951, and 1954, respectively.

In 1949, the Nevada range people organized the Nevada Section of the ASRM, and John was elected to be the Section's first secretary-treasurer. In 1950, John's work assignment office was on the University of Nevada campus, although he continued the fieldwork at Paradise Valley. In July 1951, because of his working relationships there on the Reno campus, he was offered and accepted an extension position at Las Vegas. He was vice president of the Section at that time. At their 1951 annual meeting in Caliente, he was elected Section president. He represented the Nevada Section at the ASRM annual meetings in Albuquerque in 1953 and San Jose in 1954. John has been a member of the Nevada Section from 1949 to 1963 and a member of the California Section since then. He also is an honorary member of the Nevada Section since 2001.

In 1955, John had the opportunity to take a leave of absence and be one of 13 Fellows in the Comparative Extension Seminar sponsored by a Ford Foundation grant and offered at Cornell University. John was accepted as a PhD candidate. He completed his degree in 1958 and was offered a teaching position to handle new groups of Seminar

Fellows and teach graduate-level extension courses as well as guide MS and PhD students there at Cornell.

While at Cornell, John's wife, Eileen, was diagnosed with multiple sclerosis. Their 3 children were pressed into more intensive family responsibilities. Both John's increasing university workload and responsibilities at home required some changes. In 1961, John reluctantly resigned his Cornell position to take a new position with the U.S. State Department, Agency for International Development (USAID) in Nigeria teaching extension education. After his first 2 years teaching at the Western Region School of Agriculture, he worked as the regional extension officer and then as regional agricultural officer for 2 years. The next two 2-year assignments were in Nigeria's capital, Lagos, as country extension adviser, assisting and teaching about 30 US extension advisers. Following this, he was eligible for a 2-year rotational assignment to the United States and went to the Federal Extension Service in Washington, DC. Home care in the United States was much more expensive than in Africa, and in time John became employed by the Food and Agricultural Organization (FAO) of the United Nations in Liberia as an extension adviser. He was able to retain retirement privileges with USAID. His second tour of duty with the FAO was in Somalia with a subsequent tour in Sierra Leone. Living conditions in those parts of Africa were getting much less pleasant, so after that tour he retired and returned to their home in San Diego, California. They spent a total of 16 years in Africa.

John remarks that his employers always had supported his activities and involvement with the Society. He has never stopped paying dues since the beginning and feels proud to be an SRM member and supporting the Society's objectives.

SRM Charter Member – Paul Krause

Editor's Note: Paul Krause, Ridgewind Assisted Living, Room 301, 4080 Hawthorne Rd, Rogerson, ID 83302. Paul Krause was interviewed in January 2004 by Paul Butler, Caribou National Forest. Paul's daughter, Karen Barber, 10315 S Lava West Dr, Lava Hot Springs, ID 83246, (208) 776-5863, was also in attendance. This synopsis is abstracted from the tape.

Paul was born in 1913. He went to the University of Montana working his way through school and received a BS in 1939. His career was spent with the Bureau of Indian Affairs (BIA) in several locations. He took the civil service exam, ranking eighth in the nation and sixth in Montana as well as taking several unassembled exams. His first job was in Enumclaw, Washington, with the US Army Corps of Engineers for $1,440 per year as an engineering aide. He wished to work in resource management, and shortly he got an offer to go with the BIA in Carson City, Nevada. However, when he and his wife got there, the housing to be used was not completed, so he was sent to Salt Lake City on temporary assignment doing resource inventories on several of the reservations in the Great Basin.

When those were near completion, he was sent to the Duck Valley reservation 100 miles north of Elko, Nevada, half in Nevada and half in Idaho. He related that the superintendent there was ordered by Washington, DC, to take him as the first range man. The man was virtually inhospitable to Paul and his small family and would not even let him come to staff meetings! In time, Paul was able to wangle a transfer from Duck Valley to Ft. Duchesne, Utah. His Salt Lake City boss apparently had no choice but to send Paul to Duck Valley, but was able to rectify that.

Paul was on the Ute Indian Reservation at Ft. Duchesne, Utah, 160 miles east of Salt Lake City, as branch chief for forestry and range management for the BIA. He worked with the Tribal Council and had 3 Indian range aides out on the 3 major divisions of the tribal land. He remarked that it was good duty. From there, he was sent to be a range man on one of the 5 major divisions of the big (15 million acres) Navajo reservation. Each of 5 men had about 3 million acres. Then he got appointed to be superintendent of one of those 5, the one he was working in, for about 4 years. The previous superintendent apparently was "a real boss, a stickler for detail." Paul was told by staff that they were glad to have a real person in the job. That also was good duty.

Paul joined the Society of American Foresters early on before the American Society of Range Management (ASRM) was started. He found out about the formation of ASRM from his contact with his old professor, Mel Morris. He had kept in contact with him after he graduated. He was working on the Navajo reservation as the head range man, and Professor Morris would take range juniors on a range tour in the West/Southwest. Paul would meet them on the west side of the Navajo reservation at the Cameron Trading Post and show them what was going on in the way of range management. The reservation was four-fifths in Arizona and one-fifth in New Mexico and about 200,000 acres in southeastern Utah. Professor Morris told him about ASRM being formed.

Paul did attend the first meeting of ASRM in Salt Lake City. His recollections of the meeting are as follows: "Quite a few of us were meeting in January 1948 in the Federal Building at Salt Lake City, and Joe Pechanec, of the Dubois Experiment Station, was in charge. He asked for 'all you guys interested in a range management organization to raise their hands,' and most did. So, he said, 'let's go across the street to the Newhouse Hotel and meet.' So, I am a real charter member." He was quite interested in joining ASRM and being involved. He was pleased that ASRM was a separate group and not a subsidiary of the Society of American Foresters. He remarked that when he got out of school, there was no source of information except periodic government bulletins and that formation of ASRM would bring research information to the fore in ways it had not been in the past.

Then he was transferred to Bemidji, Minnesota, for all the Indian reservations in Minnesota and 3 little reservations in northeastern Nebraska. He said that was rough duty, as there were many Indians and very little land on a number of reservations, 8 in Minnesota alone. They had to work for a living during the week, so they were able to have meetings only on weekends. In the summers, many Indians worked in the resorts on the many lakes there. People would come up there in droves from all over the country and stay for a week or so at resorts on lakes. This meant many weekend meetings, driving in snowstorms, and so on. One time he was traveling with a lawyer for one of the tribes when a blizzard grounded them. They holed up in a motel for 4 days before the storm eased up enough to let them out. Paul was there about 4 years.

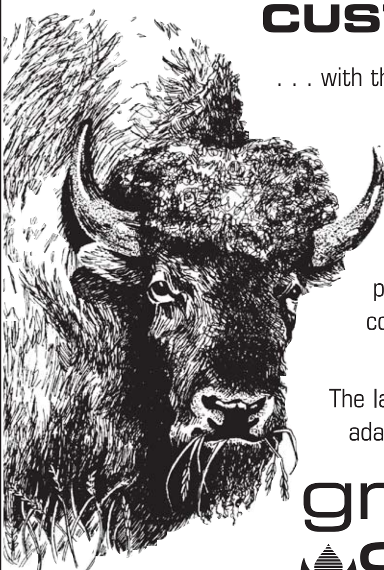
Following that, he became the head range man for the big Navajo reservation at Window Rock, Arizona. That was good duty. His family lived in Arizona 20 miles from Gallup, New Mexico, as he covered the Arizona, New Mexico, and Utah area. He relates the first time he met with the Tribal Resources Committee. The chairman said, "I suppose you're one of these young whippersnappers who are going to come in here and tell us Navajos how to run livestock, how to run sheep." Paul said, "No." He said, "Sheep are a tradition with us." Paul said, "Yeah, ever since the 1500s your ancestors swiped them from the Spanish conquistadores." He laughed and said, "You've read your history and done your homework. I suppose now you'll come down here and tell us how to run things." Paul said, "No, I know you know a lot of stuff, and I know a little bit. Let's put what we know together and see what happens." So they got along well. Paul was there for quite a while. He believes he must have been there in the early 1950s, as his daughter was in sixth grade when he went to Window Rock.

Eventually, he wound up in the area office in South Dakota, from where he retired. That position required a lot of traveling, but it was good duty. The man who was director retired about the time Paul got there, and they sent in a young man who was part Indian to take it over. He had been sent back to Washington, DC, for a couple of years to work all through the BIA system and wound up being appointed superintendent in South Dakota. He was one of 3 or 4 fellows who were deemed "most likely to succeed."

He knew Paul from his days in Minnesota. While there, Paul had a fight with one of the tribal councilmen on one of the reservations at Leech Lake, and the Indian was out to get Paul fired because he would not allow them to do things that were against federal regulations. And even their sons who would meet him on the streets would say, "Your days are numbered, Dad's going to run you out." Paul said to them, "You know what? He is telling so much stuff to the Minneapolis Trib and the TV over in Duluth that he was going to make me famous. One of these days I may be offered a real good job somewhere. You go tell that to him." Paul remarked that those were interesting times.

Paul retired in the late 1960s. He never held any ASRM offices and many times could not get to meetings. He needed to be on the program in order to get per diem to attend, and he said he wasn't well enough known to be on programs. He concludes by stating his belief that SRM has done well over the years and certainly met his expectations.

Tom Bedell is a member and former chairman of the SRM History Committee and a member of the Pacific Northwest Section living in Philomath, Oregon, tbedell@peak.org.



Jeff Mosley

Browsing the Literature

This section reviews new publications available about the art and science of rangeland management. Personal copies of these publications can be obtained by contacting the respective publishers or senior authors (addresses shown in parentheses). Suggestions are welcomed and encouraged for items to include in future issues of *Browsing the Literature*. Contact Jeff Mosley, jmosley@montana.edu.

Animal Ecology

Habitat associations and population trends of two hawks in an urbanizing grassland region in Colorado. E. Schmidt and C. E. Bock. 2005. *Landscape Ecology* 20:469–478. (C. Bock, Dept. of Ecology and Evolutionary Biology, Univ. of Colorado, Boulder, CO 80309). Numbers of rough-legged hawks declined dramatically while red-tailed hawk numbers increased dramatically as exurban development altered a treeless grassland during the past 30 years.

Grazing Management

Candidate cool-season legumes for filling forage deficit periods in the southern Great Plains. S. C. Rao, B. K. Northup, and H. S. Mayeux. 2005. *Crop Science* 45:2068–2074. (USDA-ARS, Grazinglands Research Lab, 7207 W. Cheyenne St., El Reno, OK 73036). Grasspea outperformed lentil and reached its maximum yield 75 days after seeding. Grasspea can provide nutritional forage during late spring in the southern Great Plains.

Cumulative forage production, forage quality and livestock performance from an annual ryegrass and cereal rye mixture in a pine walnut silvopasture. R. L. Kallenbach, M. S. Kerley, and G. J. Bishop-Hurley. 2006. *Agroforestry Systems* 66:43–53. (Plant Science Unit, Univ. of Missouri, Columbia, MO 65211). "Beef producers using a annual ryegrass/cereal rye in a silvopasture system likely would not sacrifice livestock production when hybrid pine and black walnut trees are 6- to 7-year-old when compared to an open pasture."

Fatty acid and sensory characteristics of beef from three biological types of cattle grazing cool-season forages supplemented with soyhulls. R. T. Baublits, A. H. Brown, F. W. Pohlman, D. C. Rule, Z. B. Johnson, D. O. Onks, C. M. Murrieta, C. J. Richards, H. D. Loveday, B. A. Sandelin, and R. B. Pugh. 2006. *Meat Science* 72:100–107. (Dept. of Animal Science, Univ. of Arkansas, Fayetteville, AR 72701). Supplementation with soyhulls did not affect tenderness of beef from grass-fed cattle, but supplementation did reduce the grassy flavor.

Grazing evaluation of big bluestems bred for improved forage yield and digestibility. R. B. Mitchell, K. P. Vogel, T. J. Klopfenstein, B. E. Anderson, and R. A. Masters. 2005. *Crop Science* 45:2288–2292. (USDA-ARS, PO Box 830937, Lincoln, NE 68583). "Bonanza" big bluestem provided greater steer production than "Goldmine," and both cultivars outperformed "Pawnee" and "Kaw" in a 3-year grazing trial.

How do the nature of forages and pasture diversity influence the sensory quality of dairy livestock products? B. Martin, I. Verdier-Metz, S. Buchin, C. Hurtaud, and J. B. Coulon.

2005. *Animal Science* 81:205–212. (INRA, Unite Rech Herbivores, F-63122 St Genes Champanelle, France). Recent experiments have shown that the botanical composition of grass diets consumed by dairy cattle affects cheese texture and flavor.

Non-destructive assessment of cattle forage selection: A test of skim grazing in fescue grassland. D. M. Moisey, E. W. Bork, and W. D. Willms. 2005. *Applied Animal Behaviour Science* 94:205–222. (E. Bork, Dept. of Agriculture, Food and Nutrition Science, Univ. of Alberta, Edmonton, AB T6G 2P5, Canada). A light defoliation in spring followed by a late-summer to dormant-season grazing period may harm rough fescue, but fall grazing alone appears sustainable.

The potential role of sheep in dryland grain production systems. H. B. Goosey, P. G. Hatfield, A. W. Lenssen, S. L. Blodgett, and R. W. Kott. 2005. *Agriculture Ecosystems & Environment* 111:349–353. (Dept. of Animal and Range Sciences, Montana State Univ., Bozeman, MT 59717). Grazing fallow cropland with sheep and goats suppressed weeds and wheat stem sawfly populations, an insect pest that decreases grain production. Weed and insect control occurred without increased soil compaction.

Hydrology/Riparian

Moist-soil plant seed production for waterfowl at Chautauqua National Wildlife Refuge, Illinois. M. W. Bowyer, J. D. Stafford, A. P. Yetter, C. S. Hine, M. M. Horath, and S. P. Havera. 2005. *American Midland Naturalist* 154:331–341. (J. Stafford, Illinois Natural History Survey, Forbes Biological Station, PO Box 590, Havana, IL 62644). Carrying capacity of migratory waterfowl was estimated to be 2.7 duck use-days per acre on moist-soil wetlands in central Illinois.

Plant diversity in riparian forests in northwest Colorado: Effects of time and river regulation. A. L. Uowolo, D. Binkley, and E. C. Adair. 2005. *Forest Ecology and Management* 218:107–114. (Dept. of Forest, Rangeland and Watershed Stewardship, Colorado State Univ., Fort Collins, CO 80523). On two rivers in northwestern Colorado, one with flow regulated by diversions and dams and one with unregulated flow, plant species richness in cottonwood riparian forests declined similarly, declining by more than 50% from young stands (<20 years old) to old stands (>250 years old).

Responses of black willow (*Salix nigra*) cuttings to simulated herbivory and flooding. S. W. Li, L. T. Martin, S. R. Pezeshki, and F. D. Shields. 2005. *Acta Oecologica—International Journal of Ecology* 28:173–180. (Dept. of Biology, Univ. of Memphis, Memphis, TN 38152). In floodplains and riparian zones of the southeastern United States, black willow appears tolerant of heavy browsing.

Measurements

Principles of obtaining and interpreting utilization data on Southwest rangelands. L. Smith, G. Ruyle, J. Maynard, S. Barker, W. Meyer, D. Stewart, B. Coulloudon, S. Williams, and J. Dyess. 2005. Univ. of Arizona Cooperative Extension Publication AZ1375. (Publications, College of Agriculture and Life Sciences, Univ. of Arizona, Tucson, AZ 85721). Discusses how percentage utilization data should be used when managing livestock grazing on upland rangelands.

Rangeland field data techniques and data applications. K. E. Spaeth, G. L. Peacock, J. E. Herrick, P. Shaver, and R. Dayton. 2005. *Journal of Soil and Water Conservation* 60:114A–119A. (USDA-NRCS, PO Box 6567, Fort Worth, TX 76115). Describes recent changes in methodologies used by the USDA Natural Resources Conservation Service to complete natural resource inventories on privately owned rangelands.

Plant/Animal Interactions

Dispersal of leafy spurge (*Euphorbia esula* L.) seeds in the feces of wildlife. E. J. Wald, S. L. Kronberg, G. E. Larson, and W. C. Johnson. 2005. *American Midland Naturalist* 154:342–357. (Dept. of Renewable Resources, Univ. of Wyoming, Laramie, WY 82071). Wild turkeys probably do not disperse leafy spurge seed, whereas sharp-tailed grouse, white-tailed deer, and mule deer may do so on a limited basis.

Plant Ecology

Changes in woodland cover on prairie refuges in North Dakota, USA. T. A. Grant and R. K. Murphy. 2005. *Natural Areas Journal* 25:359–368. (U.S. Fish and Wildlife Service, 681 Salyer Rd., Upham, ND 58789). Provides evidence that deciduous woodlands have expanded significantly into National Wildlife Refuge prairie grasslands during the past 100 years.

Elevated CO_2 and defoliation effects on a shortgrass steppe: Forage quality versus quantity for ruminants. D. G. Milchunas, A. R. Mosier, J. A. Morgan, D. R. LeCain, J. Y. King, and J. A. Nelson. 2005. *Agriculture Ecosystems & Environment* 111:166–184. (Dept. of Forest, Rangeland and Watershed Stewardship, Colorado State Univ., Fort Collins, CO 80523). Elevated amounts of atmospheric carbon dioxide decreased crude protein concentration and digestibility of the forage. Defoliation increased the amount of protein and energy in the forage compared with nondefoliated plants regardless of atmospheric carbon dioxide concentrations.

Invasive plants of range and wildlands and their environmental, economic, and societal impacts. C. L. Duncan and J. K. Clark (eds.). 2005. ($20; Weed Science Society of America, 810 E. 10th St., Lawrence, KS 66044-8897). This 222-page book summarizes scientific literature regarding the economic, environmental, and societal losses caused by 16 major invasive plants on US rangelands.

Land management history and floristics in mixed-grass prairie, North Dakota, USA. R. K. Murphy and T. A. Grant. 2005. *Natural Areas Journal* 25:351–358. (U.S. Fish and Wildlife Service, PO Box 578, Kenmare, ND 58746). Native plant species occur more commonly on private lands grazed by cattle than on adjacent National Wildlife Refuge lands that have been excluded from livestock grazing for the past 70 years.

Multi-scale impacts of crested wheatgrass invasion in mixed-grass prairie. D. C. Henderson and M. A. Naeth. 2005. *Biological Invasions* 7:639–650. (Dept. of Renewable Resources, Univ. of Alberta, Edmonton, AB T6G 2H1, Canada). Plant diversity was lower where crested wheatgrass had invaded northern Great Plains grasslands, but vegetation and litter biomass were greater. In the soil, amounts of organic matter, carbon, total nitrogen, and total phosphorus did not differ.

Rehabilitation/Restoration

Establishing *Artemisia tridentata* ssp. *wyomingensis* on mined lands: Science and economics. G. E. Schuman, L. E. Vicklund, and S. E. Belden. 2005. *Arid Land Research and Management* 19:353–362. (USDA-ARS, High Plains Grasslands Research Station, 8408 Hildreth Rd., Cheyenne, WY 82009). "Our research has shown that reducing grass seeding rates will reduce competition and result in larger sagebrush plants that are more likely to survive and provide greater structural diversity to the plant community."

Managing native invasive juniper species using fire. R. J. Ansley and G. A. Rasmussen. 2005. *Weed Technology* 19:517–522. (Texas Agricultural Experiment Station, 11708 Highway 70 South, Vernon, TX 76384). Discusses rates of juniper encroachment relative to presettlement fire regimes and the effects of using prescribed fire to treat these rangelands.

Medusahead control with fall- and spring-applied herbicides on northern Utah foothills. T. A. Monaco, T. M. Osmond, and S. A. Dewey. 2005. *Weed Technology* 19:653–658. (USDA-ARS, Forage and Range Research Lab, 690 North 1100 East, Logan, UT 84322). Potential exists to use sulfometuron or imazapic herbicides to suppress medusahead, an aggressive, nonnative, winter annual grass.

Seed germination and viability of Wyoming sagebrush in northern Nevada. C. A. Busso, M. Mazzola, and B. L. Perryman. 2005. *Interciencia* 30:631–637. (Dept. of Agronomy, Univ. Nacional Sur, CERZOS, RA-8000 Bahia Blanca, Buenos Aires, Argentina). When Wyoming big sagebrush is used for restoration, relatively heavy seeds should be used because they have the greatest germination potential.

Socioeconomics

Attitudes of rural landowners toward wolves in northwestern Minnesota. A. S. Chavez, E. M. Gese, and R. S. Krannich. 2005. *Wildlife Society Bulletin* 33:517–527. (US Fish and Wildlife Service, 6010 Hidden Valley Rd., Carlsbad, CA 92009). Rural residents both within and outside of areas inhabited by wolves had negative attitudes toward wolves.

Mentoring guidelines for wildlife professionals. K. M. S. Wells, M. R. Ryan, H. Campa, and K. A. Smith. 2005. *Wildlife Society Bulletin* 33:565–573. (Missouri Dept. of Conservation, 1110 South College Ave., Columbia, MO 65201). Provides guidelines for successful mentoring relationships between senior and early-career professionals, including strategies for successful matching and managing the mentoring process.

HIGHLIGHTS

Rangeland Ecology & Management, January 2006

Applying Improved Estimates of MODIS Productivity to Characterize Grassland Vegetation Dynamics

Matthew C. Reeves, Maosheng Zhao, and Steven W. Running

The efficacy of Moderate Resolution Imaging Spectroradiometer (MODIS)-derived vegetation productivity was tested to characterize fluctuations in aboveground green biomass and provide regional perspectives of interannual vegetation dynamics. The relationships between MODIS net photosynthesis estimates and scaled aboveground green biomass improved steadily during the progression of each growing season (r^2 = 0.77 and 0.57 in 2001 and 2002, respectively). We characterized interannual variability in grassland vegetation through analysis of MODIS-derived net primary productivity for the years 2001 to 2003. MODIS data may be more useful for addressing administrative, rather than managerial, needs given the coarse resolution and regional perspective of the vegetation products.

Comparison of Stocking Rates From Remote Sensing and Geospatial Data

E. Raymond Hunt Jr. and Brian A. Miyake

Remote sensing data from the Advanced Very High Resolution Radiometer have coarse spatial resolution and high temporal resolution, which can be used to estimate regional net primary production. The 12-year average of net primary production was used to calculate stocking rates in animal-unit months per acre for the state of Wyoming. Stocking rates were also calculated from 1:500,000-scale soil and climate geospatial data layers based on stocking rates from the US Department of Agriculture Natural Resource Conservation Service. Remote sensing indicates the actual condition of vegetation, so this is an important step in the development of regional forecasting of range condition, trend, and projected stocking rates.

A Protocol for Retrospective Remote Sensing-Based Ecological Monitoring of Rangelands

Robert A. Washington-Allen, Neil E. West, R. Douglas Ramsey, and Rebecca A. Efroymson

The degree of rangeland degradation in the United States is unknown because of the failure of traditional field-based monitoring to capture the range of variability of ecological indicators and disturbances at regional to national spatial scales and temporal scales of decades. Consequently, a protocol is presented for retrospective monitoring and assessment of rangeland degradation using historical time-series of remote sensing data and catastrophe theory as an ecological framework. Characteristics of land degradation were retrospectively measured for a nearly 33-year trend using surrogate remote-sensing–based indicators that correlate with changes in life-form composition, vegetation productivity, accelerated soil erosion, soil quality, and landscape.

Evaluation of High-Resolution Satellite Imagery for Assessing Rangeland Resources in South Texas

J. H. Everitt, C. Yang, R. S. Fletcher, and D. L. Drawe

Because of the generally great expanse and inaccessibility of rangelands, determining their botanical characteristics by ground surveys is time consuming and expensive. QuickBird high-resolution (2.8 m) satellite imagery was evaluated for differentiating among rangeland cover types on the Welder Wildlife Refuge in south Texas. Unsupervised image analysis techniques were used to identify major cover types with overall accuracies ranging from 79% to 89%. These results indicate that QuickBird imagery can be a useful tool for identifying rangeland cover types at a regional level.

Challenges of Integrating Geospatial Technologies Into Rangeland Research and Management

Keith T. Weber

This paper describes many of the tools and techniques available for geospatial analysis and provides suggestions to users to promote use of these tools. Of critical importance are 1) coregistering field samples with satellite imagery to ensure that the field sample is inside the correct pixel and 2) using GIS and satellite imagery to accurately map and monitor rangelands. Land managers have an increasing number of duties and a limited amount of time. It is impractical to monitor rangelands without the application of geospatial tools.

Estimating Biophysical Characteristics of Musk Thistle (*Carduus nutans*) With Three Remote Sensing Instruments

Mustafa Mirik, Karl Steddom, and Gerald J. Michels Jr.

Identifying the dynamics and extent of noxious weeds in a spatial and temporal context improves monitoring, planning, and management. Musk thistle (*Carduus nutans* L.), a noxious weed, is a good candidate for detection by remote sensing platforms because it may produce a unique spectral signature. This study indicated that normalized difference and simple ratio indices can be used for specific applications such as detection of musk thistle's biophysical variables in rangelands. These results can produce a map of parameters useful in determining the size of infestation and the reduction in rangeland productivity.

Measured Sediment Yield Rates From Semiarid Rangeland Watersheds

M. H. Nichols

Sediment is one of the principle pollutants of surface water in the United States; however, data describing long-term sediment yield rates on semiarid rangeland watersheds are relatively rare. Sediment yields from 8 subwatersheds within the US Department of Agriculture–Agricultural Research Service Walnut Gulch Experimental Watershed in southeastern Arizona were computed from stock-pond sediment measurements. Sediment accumulation records ranging from 30 to 47 years were evaluated for subwatersheds ranging in size from 35.2 to 159.5 ha. Sediment yield ranged from 0.5 to 3.0 $m^3 \cdot ha^{-1} \cdot y^{-1}$. This research is providing information that can be used to evaluate the impacts of watershed management on downstream sediment yield.

Seed Production and Dispersal of Sulfur Cinquefoil in Northeast Oregon

Kathleen A. Dwire, Catherine G. Parks, Michael L. McInnis, and Bridgett J. Naylor

Sulfur cinquefoil is an invasive herbaceous perennial that is rapidly spreading throughout the interior Pacific Northwest. We measured seed production and dispersal at infested sites in different habitats in northeast Oregon. Annual seed production was approximately 6,000 seeds per plant; seeds (achenes) were dispersed from July through mid-October and approximately 83% of the seeds were captured within 60 cm of the source plants. These results suggest that once sulfur cinquefoil reaches a site, it spreads and persists by releasing numerous viable seeds near parent plants. Prevention of annual seed set and dispersal will assist in managing the local expansion of sulfur cinquefoil.

Vegetation on Gunnison's Prairie Dog Colonies in Southwestern Colorado

Madeline N. Grant-Hoffman and James K. Detling

Research focused on black-tailed prairie dogs has often been extrapolated to other prairie dog species. We studied the effects of Gunnison's prairie dogs on plant cover and biomass, canopy height, and nitrogen concentration. We found no significant differences in plant cover and biomass, canopy height, and plant diversity on and off Gunnison's prairie dog towns, and only 1 of 4 focal plants showed a significant difference in nitrogen concentration on and off towns. This research indicates that the magnitude of differences on and off prairie dog towns may be dependent on the ecosystem and species of prairie dog.

Elk, Mule Deer, and Cattle Foraging Relationships on Foothill and Mountain Rangeland

Wendy L. F. Torstenson, Jeffrey C. Mosley, Tracy K. Brewer, Michael W. Tess, and James E. Knight

Knowing when and where significant foraging niche overlap is likely to occur can help resource managers sustain wild and domestic ungulates in the northern Rocky Mountains. We studied food habits and grazing distribution of elk, mule deer, and cattle and found that elk in spring had high foraging niche overlap with cattle in summer and fall. That is, in spring, elk foraged in many of the same places (largely foothill sagebrush grasslands) and ate diets (principally perennial bunchgrasses) similar to what cattle did in summer and fall. We recommend that resource managers focus their forage utilization and rangeland trend monitoring in foothill sagebrush grasslands.

Restoration of Quaking Aspen Woodlands Invaded by Western Juniper

Jonathan D. Bates, Richard F. Miller, and Kirk W. Davies

Western juniper woodlands are rapidly replacing lower elevation quaking aspen stands in the northern Great Basin. We evaluated 2 juniper removal treatments involving partial cutting of juniper trees to increase cured surface fuel loads, followed by fall burning or spring burning. The fall burn was more effective at eliminating remaining juniper and stimulating aspen suckering, whereas the spring burn was more effective at increasing understory cover and diversity. The study demonstrates that partial cutting of conifers followed by prescribed fire is effective at restoring aspen woodlands and that the severity of the burning disturbance is influenced by season of burn.

Response of Two Semiarid Grasslands to a Second Fire Application

Carleton S. White, Rosemary L. Pendleton, and Burton K. Pendleton

Degraded rangelands contribute sediment that lowers stream water quality; these degraded rangelands are also susceptible to invasion from woody plants. We reintroduced fire to 2 semiarid grasslands to try to stimulate grass production and reduce cover of woody plants. Fire reduced cover of juniper shrubs and trees, reduced the number of cholla cactus and the size of prickly pear cactus, but the loss of total plant cover after the fires increased the potential for greater erosion until plant cover returned. The benefits of returning fire to grasslands must be balanced with the cost of higher potential erosion.

The Recipe Corner

Editor's Note: There are many "family" recipes that are passed from generation to generation and never seen by outsiders. Many of these recipes would be enjoyed by others. This column has been established to present some of these recipes so others can enjoy them. The following recipe was submitted by Joe Brummer, Gunnison, Colorado, jbrummer@lamar.colorado.edu.

Simple Dutch Oven Cobbler

A lot of Boy Scout activities take place outdoors and include campfire cooking. This recipe was something I picked up when my son was in the Scouts.

2 (21-ounce) cans of your favorite pie filling (apple and cherry are my favorites)
1 box yellow cake mix
1 stick of butter or margarine

Build a campfire and let it burn down to the coals. For easier cleanup, I line my Dutch oven with aluminum foil. Place the pie filling on the bottom. Add the cake mix dry. Cut the stick of butter or margarine into thin pats and spread them over the top of the dry cake mix. Cover the oven with the lid and place over low to medium heat with some coals on top. Check after 30 minutes. This makes a heavy but rich cake on top of the pie filling.

BOOK REVIEW

Birds of the Middle East. By R. F. Porter, S. Christensen, and P. Schiermacker-Hanson. 2004. Princeton University Press, Princeton, NJ. 460 p. US$35.00 paper. ISBN 0-691-12104-4.

Professional ornithologists and both serious and casual bird-watchers will appreciate *Birds of the Middle East,* an impressive new field guide. Apparently, this book was originally published in 1996 by another publisher but has been republished by Princeton University Press.

Birds of the Middle East was designed to be a comprehensive field guide as of 1996 for a large area that includes in their entireties the countries of Bahrain, Cypress, Iran, Iraq, Israel, Jordan, Kuwait, Lebanon, Oman, Qatar, Saudi Arabia, Syria, Turkey, the West Bank and Gaza, the United Arab Emirates, and the Republic of Yemen (including the remarkable island of Socotra). In all, the authors describe 722 species.

In a brief introduction, the authors, using 7 illustrations, present the *topographic* terminology used to describe birds, then follow with an oddly placed acknowledgments page. Next in *Birds of the Middle East* are 112 color plates, one plate to a page. Each plate pictures from 5 to 10 species of birds, with multiple pictures for each species. Both male and females are pictured, as are (sometimes) juvenile specimens or seasonal, local, or regional variations. Opposite each plate page is the scientific name of each species, a common name for each species, brief descriptions of the status and habitat of each species, and a small map of each species' distribution. Following the section of plates, the authors provide descriptions of the bird species that include descriptions of appearance, behaviors, voice, flight (eg, wing beat), and other relevancies and curiosities. The book concludes with a list of important references on birds for each country, a complete species list, an index of common names, and an index of scientific names. The book is entirely in English and contains no Arabic or other languages.

The layout of *Birds of the Middle East* is attractive and effective. The maps, while small, are high in resolution, and the bird plates too have excellent resolution. The book offers most of what any professional or enthusiast would want in a field guide.

Although much of the Middle East is desert or semidesert, a significant number of arboreal, aquatic, and marine birds are found at least *somewhere* in the region. As a result, the bird list and the book's coverage are impressive, and *Birds of the Middle East* is much more relevant to North America than many would think. Darters, cormorants, swifts, swallows, pelicans, waxbills, flycatchers, kingfishers, warblers, thrushes, a hornbill—they are all pictured here, and some of the species are the same as those in North America or are nearly indistinguishably close relatives. As I evaluated this book, I couldn't help thinking how insignificant and underappreciated these birds are amid all the region's economic obsessions, religious contentions, and general petro-political ruckus. Somehow, despite—or maybe because of—all our freeways, condos, philosophies, and other manifestations of human ingenuity we pursue in our efforts to exploit, explode, overpopulate, heat up, or otherwise destroy our only planet, those birds are somehow better than we are. So with this fine avian field guide, you can see all that and more in the plates of those surprisingly familiar birds of the Middle East, and you won't even need infrared binoculars.

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